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CONTENTS

WEST EUROPE

AEROSPACE, CIVIL AVIATION

FRG's Saenger Hypersonic Aircraft Funded Through 1992
[Hans-Dieter Hamboch; Bonn RHEINISCHER MERKUR/CHRIST UND WELT, 3 Mar 89] 1
Thomson-CSF Advanced Simulator Activities Outlined *[Rome AIR PRESS, 22 Feb 89]* 2
French Government Approves Space Industries Holding Company
[Rome AIR PRESS, 8 Mar 89] 3
France: Preliminary Research on Supersonic Aircraft Discussed *[Rome AIR PRESS, 8 Mar 89]* 4
Italy, Turkey To Cooperate in Aviation Sector *[Rome AIR PRESS, 8 Mar 89]* 5
Italian-French Satellite, Future Launch Described *[Rome AIR PRESS, 19 Mar 89]* 5
Italy: Technical Specifications of "Grifo" Radar Discussed *[Rome AIR PRESS, 8 Mar 89]* 7
SNIA BPD's Defense, Space Programs Described *[Rome AIR PRESS, 10 Mar 89]* 7

AUTOMOTIVE INDUSTRY

Automation Increases Fiat Productivity
[Harald Jung; Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT, 24 Feb 89] 8

COMPUTERS

French, FRG, British Research in Neural Computing Examined 9
Thomson-CSF
[London PROCEEDINGS OF THE SECOND EUROPEAN SEMINAR ON NEURAL COMPUTING, 16-17 Feb 89] 9
Siemens 11
British Telecom 14

FACTORY AUTOMATION, ROBOTICS

FRG Funds CIM Project Development
[Josef Koenig; Frankfurt/Main FRANKFURTER RUNDSCHAU, 15 Mar 89] 17
Decline in FRG Industrial Robot Production Analyzed
[Frankfurt/Main FRANKFURTER ALLGEMEINE, 8 Apr 89] 18
Status of FRG Factory Automation, Robotics 19
CIM Application *[Reinhold Boehmer; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89]* 19
Assembly *[Dieter Duerand; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89]* 21
Sensors *[Dieter Duerand; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89]* 23
Precision Machining
[Reinhold Boehmer; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89] 23
High-Speed Metal Cutting
[Reinhold Boehmer; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89] 24
Quality Control *[Christian Sachse; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89]* 26
Maintenance *[Christian Sachse; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89]* 27
Materials Handling *[Martin Muras; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89]* 28
Computer Simulation
[Andreas Molitor, Reinhold Boehmer; Duesseldorf WIRTSCHAFTSWOCHE, 24 Mar 89] 29

MICROELECTRONICS

FRG Laender Compete for JESSI Projects
[Roland Tichy; Duesseldorf WIRTSCHAFTSWOCHE, 31 Mar 89] 30

TELECOMMUNICATIONS R&D

RACE Projects and Proposals Outlined 32
Program Status
[Brussels COMMISSION OF THE EUROPEAN COMMUNITIES, 23 Jan 89] 32
Projects, Proposals Listed
[Brussels COMMISSION OF THE EUROPEAN COMMUNITIES, 23 Jan 89] 34

EAST EUROPE

COMPUTERS

Hungarian Software Market Evaluated 37
Trade in Experts Rather Than Products
[Katalin Magos; NEPSZABADSAG, 20 Mar 89 p 8] 37
Independent Authors Also Involved in International Trade
[Gyorgy Palos; BudapestNEPSZABADSAG, 20 Mar 89] 38

FACTORY AUTOMATION, ROBOTICS

Integrated Machining Production System Being Developed by Videoton
[Bela Sveda, Denes Papp; MAGYAR ELEKTRONIKA No 3, 1989] 38
Mechanical CAD/CAM Systems for TPA 11/500 Computers Described
[Bela Mohacsi; MAGYAR ELEKTRONIKA, No 3, 1989] 42
Hungarian CAD/CAM Developments Described 47
Teaching, Research Network at Heavy Industry University Discussed
[Budapest COMPUTERWORLD/SZAMITASTECHNIKA, 18 Feb 89] 47
Model CAD/CAM System at Budapest Technical
[Gitta Takacs; COMPUTER WORLD/SZAMITASTECHNIKA, 18 Feb 89] 47
Raba Factory Takes the First Steps
[Andras Dusza; Budapest COMPUTER WORLD/SZAMITASTECHNIKA, 18 Feb 89] 48
Videoton's CADNET System Described
[Janos Czupy, Lajos Gacs; MAGYAR ELEKTRONIKA, No 3, 1989] 49

SCIENCE & TECHNOLOGY POLICY

Hungarian Research Institutes Form Electronics Companies
[Katalin Magos; NEPSZABADSAG, 25 Mar 89] 51

AEROSPACE, CIVIL AVIATION

FRG's Saenger Hypersonic Aircraft Funded Through 1992

36980175b Bonn RHEINISCHER MERKUR/CHRIST UND WELT in German 3 Mar 89 p 5

[Article by Hans-Dieter Hamboch: "Bonn's Decision on the Saenger Aircraft: Paris Challenged With Hypersonics"]

[Text] With a hypersonic aircraft that would limit the use of present-day carrier rockets to transporting only the heaviest of loads, the FRG government hopes to assail, for the first time, France's preeminent position in the European space industry. After the fundamental agreement by the Budget Committee to earmark DM 220 million for the technical study on the "Saenger" plan through 1992, Minister for Research & Technology Heinz Riesenhuber appeared confident that the two-stage space shuttle could be developed as the leading European system. The Ministry for Research & Technology (BMFT) sees competition for the ambitious project, which in the view of serious scientists will probably not be ready to be deployed for another 20 or 30 years, only in the American NASP system. In contrast, it is believed that Great Britain's "Hotol" will not be feasible after the Thatcher government's financial retreat.

Also involved in financing the preliminary study for the "Saenger" system—the total costs of which, up to the maiden flight, will be in the tens of billions of Deutsche marks—are the German Research Institute for Aeronautics and Astronautics (DLR), industry and the German Research Community. Within the next 4 years, they will raise an additional sum of around DM 150 million for the hypersonic technology sponsorship plan.

As Riesenhuber said at a press conference, "the FRG, as one of the leading technological nations, cannot afford to observe the exploration of space from the second row." He said that the country must be engaged in technologically oriented fundamental research and contribute its experiences to the international store of know-how. With "Saenger," the FRG government is thus pursuing system leadership in a conceivable association between ESA, NASA and the Japanese, Riesenhuber said.

The thrust of the action of obvious. It is aimed at the French, who currently dominate European astronautics. In the past, Paris has had a knack for assuming the leadership role, both with the "Ariane" carrier rocket and with the "Hermes" shuttle. Even Airbus, a joint product of five European countries, is assembled under French guidance. The image has paid off for French science and industry.

If, before the summer vacation, the DLR and four universities interested in setting up special hypersonic research departments get around to using computers to tackle the theoretical model developed before the Second World War by Prof Eugen Saenger, then they can fall back on preliminary studies that are already under way, since the aerospace conglomerate MBB [Messerschmidt-Boelkow-Blohm], the DLR and the engine manufacturer MTU [Motoren- und Turbinenunion] have all been working on the aircraft of the future for some time now. Thus, the DLR is studying the ideal shape of the lower and upper stage in the wind tunnel of the Institute for Fluid Mechanics in Goettingen, while MTU is testing, behind closed doors, the initial models of a new generation of power units.

With "Saenger," scientists and engineers are venturing into an unknown area. Difficulties have been discerned already. The biggest problem is expected with the lower stage of the fully reusable carriage, which takes off and lands like a normal airplane, because no one anywhere has any experience with adjustable power units in the range of seven Mach (around 8,000 km/h), nor with hydrogen-propelled jets. There is less concern about the upper stage, which is transported piggyback, detaches from the carrier at an altitude of 30 kilometers and takes off into space with liquid oxygen. Here it is possible to fall back on the extensive experience of the Americans with their space shuttle.

Bonn's decision, one heavily laden with financial and technological risks, is based on a draft proposal by MBB. The Munich firm came up with six points that support construction of the airplane-like space shuttle. Of significance to the Budget Committee's approval of the subsidy plan here was the reduction of payload costs from currently $8,000 per kilogram to $1,000-2,000, as well as the use of environmentally safe hydrogen engines, which ensure clean combustion.

Still, there are reasonable doubts about the high degree of safety posited by the Ministry for Research & Technology on the basis of the horizontal takeoff, because it is in fact the incalculable risks that even experts employed in the aerospace industry are warning about. They reject the possibility of takeoffs and landings at civilian airports or flying over densely populated areas, since the "Saenger," loaded up with just under 200 tons of hydrogen and liquid oxygen, is equivalent to a flying superbomb. If it were to crash, a powerful explosion of the volatile fuel mixture would wipe out an entire small city, and even the refueling of the hypersonic space shuttle, which sets course for space only after it is over the equator, raises problems that equal those of "Saenger" construction. It is with good reason that ESA, NASA and the Soviets fire their similarly refueled space rockets over uninhabited areas.

The basic work by the DLR and at college institutions until 1993 is limited to engine technology, aerodynamics, materials and the construction and operation of test facilities. Only then will Bonn reach a decision about continuing the program. According to expectations by the Ministry for Research & Technology, an experimental unit is conceivable in 1999 at the very earliest. The

rest of the timetable provides for a decision in 2004 by the ESA Council of Ministers on whether the hypersonic transport system should go into the development phase.

Total costs cannot be verified, even in approximate terms. At Riesenhuber's ministry, it is known only that they "will be considerably higher than the costs of the European 'Hermes' shuttle." But even "Hermes" could easily turn out to be three times as expensive as the currently estimated DM 12 billion.

Admittedly, it is not possible to dismiss regarding the French "Hermes" program as an interim stage to "Saenger." "That would be like going directly from the bicycle to the electric locomotive," says a prominent scientist from the DLR. Experience gained with "Hermes" in the area of thermal and dynamic airframe stress in particular should benefit "Saenger."

Despite clearly outstanding prospects for new trends in classical space technology as well, Riesenhuber applies a brake to all euphoria: "We are on a course that is modestly promising. But we are not guaranteeing success."

Thomson-CSF Advanced Simulator Activities Outlined

MI890180 Rome AIR PRESS in Italian 22 Feb 89 pp 336-340

[Text] The requirements of the French Air Force and other branches of the French military for basic, advanced, and operational training and the increasingly widespread use of simulators in the training of civilian aircraft crews provides the basic drive behind the remarkable technological development of this field in the French aerospace equipment industry—as AIR PRESS reports upon completion of its recent round of visits to French aerospace industries. Additional impetus is provided by success in the export market (particularly in the number of customers). This applies to the various models of the Mirage series in the military sector, and to the twin-engine Airbus and two-turbine ATR jets in the civilian aircraft sector.

Within this frame of reference, a leading role in worldwide technological and industrial competition is being played by Thomson-CSF, a member of the Thomson Group—a giant corporation that includes 138 companies (76 in France and 62 abroad) with 150 factories and technical manufacturing, research, and maintenance centers, 50 of which are located overseas.

According to AIR PRESS, 53% of the Group's 86,000 employees and 55% of its Fr 60,200 million in total sales are accounted for by the Thomson-CSF subgroup. Thomson-CSF is committed to consolidating specialized resources in electronics (not only for aerospace) and for defense systems. In defense systems, the simulator sector is one of the fastest-growing assets of the 54-company subgroup (including 36 French and 18 foreign subsidiaries, including SGS of Alzate Brianza, Milan). A quarter of these—accounting for a total of 14,000 employees—are involved in the aerospace sector proper, with activities ranging from on-board radars to ECM systems, from automatic tracking heads for missiles to aircraft equipment and displays, down to flight simulators and simulators for many other high-technology activities in the defense and energy sectors.

In fact, Thomson-CSF is one of the few companies world-wide that are involved in all areas of simulation from basic pilot training, to simulation for switching to more advanced aircraft (even with "zero flight hours"), to military training for air combat and ground attack missions. Ad hoc simulators have been developed for airplanes, helicopters, and various weapons systems. A special simulator for the Hermes spacecraft is now being studied. Naval simulators can be developed for the various functions on board merchant ships, warships, and submarines. Ground simulators have been developed for mobile operations such as the control of tanks or firing with lightly-armed tactical infantry groups. Special simulators have been manufactured for training employees of nuclear power stations as well as for instructing personnel on how to tackle potential emergencies. On the whole, some 400 simulators of all kinds produced by Thomson-CSF are operational throughout the world or are under construction at the company's simulator division, which registered total sales of Fr 50 million in 1988 and employed 850 people in its Trappes and Cergy plants. In the same year, orders were placed for another 18 simulators, seven of which were for various models of the Airbus. The company is obviously world leader for these airplanes.

Burtek, a wholly-owned subsidiary, was established in Tulsa, Oklahoma to ensure better coverage of the U.S. market. The company employs some 150 people, and in 1987 acquired orders for 14 million dollars, particularly for the construction of components and the maintenance of simulation systems.

However, it is in the sector of military simulators—aircraft, helicopters, or tanks—that Thomson-CSF claims absolute leadership in Europe and the world. One of the most important factors behind the company's success is its ability to reproduce extremely realistic situations on the ground in addition to cockpit simulation and any other of the trainee's working situations. Heavy investments in research (Fr 5,750 million in 1987, 54% of which was self-financed, as company officials emphasized during the visit), led to the development of the VISA 4 visualization system. The system is basically capable of generating images that are perfectly consistent from any perspective, with a very high level of realism by any standard: depth of field, continuous variations in light and color from bright daylight to pitch-dark, fluidity in movement, and details of the

ground, landscape, and targets both from a distance and close up. All of this is supplemented by the realism of the other simulation factors: equipment, noise, acceleration, radio communications, etc.

The system, which has recently been ordered by the FRG Army for its 24 Leopard drive-and-fire tank simulators, offers a high degree of flexibility for integration in every type of aerospace simulator, since the project specifications are based on such simulators. The first system developed for this purpose is, in fact, an operational simulator for the Mirage 2000N.

Last year, the French Air Force placed an order with Thomson-CSF for its new Janus-Mars image-projecting system that will be used in the future on its Mirage 2000 simulator. This system offers the pilot 360° visibility by removing all the projector supports and brackets from the interior of the simulator.

The Mirage 2000 simulator will be operational by the end of 1989 at the Orange Air Base. The simulator will be used to train pilots to carry out complex, realistic missions such as reconnaissance or air-to-ground and air-to-air attacks in all weather and in all situations. The simulator includes a cockpit with a design similar to that of the Mirage 2000, located at the center of a sphere measuring 8 meters in diameter, an interactive seat for the instructor equipped with multimode color screens, and a readily accessible interface.

The Mars system for target projection features visible, low-power dual laser beams, located out of the pilot's vision on either side of the cockpit. Laser scanning is used to achieve exceptional contrast, which results in improved target definition without causing a halo effect. The Janus system features two "fish-eye" lenses for the simultaneous projection of ground and sky images in front of and behind the cockpit. The breadth of the visual range provided by these two images gives the pilot the necessary indications concerning the position, altitude, and speed of the aircraft. Janus is equipped with the VISA 4 synthetic visualization system for daytime, developed by Thomson-CSF.

At the same time, the French Air Force has ordered the equipment for the third sphere of the aerial combat simulator of the Mont de Marsan Military Aircraft Test Center (CEAR). This sphere, which will be operational by the end of the year, will offer the opportunity to train pilots in aerial combat two against one or even two against two, including a fourth aircraft piloted by the instructor.

Ordered in 1985, the CEAM's aerial combat simulator is a training system designed and developed by Thomson-CSF. The two spheres that are currently operational are capable of simulating combat between two Mirage F-1's, between two Mirage 2000's, or between a Mirage F-1 and a Mirage 2000. The four cockpits (two Mirage 2000's and two Mirage F-1's) are interchangeable and the entire configuration can be changed within 2 hours. The third sphere will be equipped with the new target-projecting system.

Finally, two simulators of the antisubmarine aircraft Atlantique 2 will be used by the French Naval Air Force. They will be installed at the naval air base at Lann Bihoue early in 1990, and at Nimes in 1991.

This type of simulator will ensure that pilots receive comprehensive training since it will include a special 6-degree cockpit shifting device and a highly advanced "Magic" instructor seat equipped with two tactile screens and easily accessible software. This simulator, together with a computerized image display system, offers excellent visualization conditions corresponding to patrol and reconnaissance situations in addition to taxiing, take-off, navigation, approach, and landing situations.

In the civil aviation sector, the company did well in 1988 with the inauguration of the first A-320 simulator at Aèroformation (the Airbus Industrie organization for training pilots and technicians), the order for two A-320 and A-310 simulators placed by Royal Jordanian Airlines, and the operational use of Korean Air's A-300-600 simulator in Seoul.

The first flight simulator for the A-320 was manufactured by Thomson-CSF in cooperation with Aerospatiale, and was inaugurated on 15 June at the Aeroformation facilities near Toulouse.

French Government Approves Space Industries Holding Company

MI890209 Rome AIR PRESS in Italian 8 Mar 89 p 427

[Text] The French avionics industrial holding company, established by a draft agreement between Aerospatiale and Thomson-CSF on 30 November 1988, is taking concrete shape: the government has approved the structure agreed upon by the companies. An industrial group centered around the Crouzet company and controlled by a holding company owned equally by Aerospatiale and Thomson-CSF will be established this summer. Crouzet will take over the two Aerospatiale companies operating in the avionics sector (SFENA and EAS), as well as Thomson-CSF's AGV [automated guided vehicles] division (Avionique Generale). AIR PRESS recalls that Crouzet specializes in navigation and radio navigation computers and in anemometer systems, while SFENA's activities cover navigation systems and flight instruments. EAS specializes in communications, and AGV in the man-machine interface.

The two major shareholders recently announced that the holding will own a little over 50% of the capital of the new company that will emerge from Crouzet's expansion. The remaining 50% is intended for a "broad and

diversified body of shareholders." Jean Segui, Thomson-CSF's current deputy director general, was appointed head of the new, and as-yet unnamed company. The new group will employ approximately 9,000 people. As AIR PRESS reveals, its yearly sales volume of Fr 5.5 billion (4 billion of this amount is generated by avionics in the strict sense of the term) places the company fourth in this sector world-wide (after Honeywell-Sperry, Litton, and Allied which, together with other industries, currently control 72% of the world market), and first in Europe.

France: Preliminary Research on Supersonic Aircraft Discussed

MI890210 Rome AIR PRESS in Italian 8 Mar 89 pp 430-431

[Text] On 2 March, approximately 3,000 people took part in a ceremony held in Toulouse to celebrate the twentieth anniversary of the Concorde's first flight. AIR PRESS reports that this occasion was used to reaffirm the importance of French participation in the program (which is often forgotten, it was emphasized) and to publicize Aerospatiale's candidacy to head an international project for a new commercial, supersonic plane. In fact, the presentation in Toulouse of studies now being carried out by the French manufacturer should be seen in this light. "Several million francs" of the company's funds have already been invested in research. They emphasized that the FRG and the UK are already willing to join the new venture, and that countries outside Europe could do the same; they are considering the United States and Japan. Henri Martre, president of Aerospatiale, has already discussed this with the Soviets.

AIR PRESS observes that it may very well prove to be the Americans with whom it will be the hardest to establish a collaboration, since enormous sums have been invested in the United States on studies of the supersonic plane as well as on the hypersonic and space planes. (AIR PRESS recalls that McDonnell Douglas and Rockwell, as well as the motor industries, have received substantial contracts for the X-30 experimental project only). There are sufficient resources for an exclusively domestic program. On the other hand, it is felt that the development of a second-generation supersonic plane is so closely related to more ambitious projects, that the industrial group creating it will prove to be the most qualified to handle the other program as well. It was recalled in Toulouse that Aerospatiale and the FRG company MBB concluded an agreement last year for the eventual union of their individual space plane projects: the STS-2000 and the Sanger. (The latter recently received the go-ahead from the Bonn government, while the competing British project HOTOL has not received new funding from London.) Italy and Spain have also stated their desire to participate in this study. At Toulouse, thermal protection was cited as one of the most difficult problems in similar programs. Expertise already exists on this subject in Europe—primarily in France, thanks to space programs, and particularly the current studies for the Hermes spaceship.

An intermediate aircraft should also be created between the supersonic plane, which in France is called the ATSF (Supersonic Transport Plane of the Future), and the space plane that is capable of flying at 25-28 Mach. This is the hypersonic plane (5-6 Mach), called AGV (High Speed Aircraft) in France. The most appropriate motor appears to be the ramjet engine; this system is as "mature" in Europe (particularly in France and the UK) as it is in the United States, which on the other hand, is more advanced in the study of other, more "exotic" systems. Capable of linking Paris to Tokyo in less than 3 hours, the hypersonic aircraft could begin service in 2020, according to French estimates—if not in 2015. This would serve as a bridge between the supersonic and the space planes in time, as well. Philippe Carlier, head of the Aerospatiale study group for advanced supersonic aircraft projects, stated in Toulouse: "It could be flying in 10 years if the public authorities were to give the go-ahead today." It can be hypothesized that the AGV will not be in use prior to 2030. (The one-seater X-30 prototype should be completed in 1995).

The new version of the preliminary ATSF project was different than the models seen at recent aerospace shows. It is derived from the general design of the Concorde, although it has a double delta instead of an ogival wing, and four motors (with 20,000 kg of thrust, compared to the 17,000 of the Concorde). Each one is mounted in its own nacelle, instead of being mounted in pairs. Its dimensions have increased a relatively small amount (the length has increased from 66 to 76 meters and wing span from 21.5 to 37 meters), but the payload (200 passengers) and range (12,000 km) have almost doubled. This has been accomplished with a mere 20% weight increase (225,000 kg at take-off), thanks to a precisely-calculated structure using computer-assisted design and new materials (CAD technology did not exist when the Concorde was designed; as a result it has an oversized structure which is troublesome, but extremely safe). The adoption of an active control system will help reduce weight (the plane has been designed according the rules of instrinsic instability, as was the hypermaneuverable fighter). The conversion to exclusively electric controls such as those on the A-320 will save one ton of hydraulic tubes and cables alone. The motors should be capable of functioning as simple turbojets at take-off and in the supersonic range, and as turbofans during subsonic cruising. Thirty-five percent savings in consumption over the Concorde's voracious "Olympus" are being predicted. All these figures have been calculated for an aircraft that will fly at 2.4 Mach. This is a relatively modest increase compared to the Concorde (which flies at 2.02 Mach), yet it is enough to worsen heating problems due to atmospheric friction. Exposed parts of the aircraft will have to withstand temperatures on the order of 200° Centigrade, against the 130° for the corresponding parts of the current aircraft.

Obviously, the second-generation supersonic aircraft under study in France is not at the definitive project stage. In the meantime, the project may undergo profound revisions based on further studies in the various

fields as well as market indicators (which might even suggest skipping this stage and proceeding directly to the hypersonic aircraft). Cooperation on the European level, at least, is being sought to rally around the project. Carlier admits that it might end up requiring slightly greater speed, and in particular, a 300-seat capacity (analagous to the capacity expected in projects underway at Boeing and McDonnell Douglas). In effect, this would mean a complete redesign.

Italy, Turkey To Cooperate in Aviation Sector

MI890208 Rome AIR PRESS in Italian 8 Mar 89 pp 424-425

[Text] The sale of the Aeritalia G-222 and the metallic construction of a third bridge across the Bosphorus—an overall total of $1 billion—might represent new contracts in Turkey. This has emerged from meetings between Romano Prodi, the president of IRI, and Prime Minister Turgut Ozal of Turkey. "We discussed the enormous possibilities that exist for relations between Italy and Turkey," Prodi stated, "not so much in the traditional field of public works as in the industrial sector. Turkey is making great progress in this area. There are concrete possibilities," he added, "not only for large industries, but also for smaller organizations in a country that appears to be following the same path as Italy in the fifties and Spain in the seventies." Ozal and Prodi examined the opportunities for collaboration between the IRI group and Turkey.

Even in the field of aeronautics there are concrete development possibilities for Aeritalia, which recently established a subsidiary in Turkey, Mediterranean Aerospace Industries. The G-222 is an aircraft the Turks are watching with much attention. AIR PRESS recalls that as early as 1983, [Italy's] late president Bonifacio attempted to establish cooperation between the Turkish aeronautics industry and Aeritalia. He presented a report with wide-ranging prospects for development even for future programs (AMX, ATR-42, etc.) IRI's mission in Turkey is to hold a series of meetings with Prime Minister Ozal and his closest colleagues in the government. The objective of these meetings is to investigate the concrete possibilities for initiatives of mutual interest in sectors where IRI has traditionally been present in Turkey as well as in new sectors. Another goal is to identify activities that permit joint ventures to be established with local companies—even for technology transfer—and perhaps operations in third countries (especially the Middle East). An additional part of IRI's mission is to verify the concrete possibilities for the group's expansion in Turkey, taking the financial aspects into consideration as well as the interest and expectations of the two sides over the form that collaboration with local businesses will take. Turkey is an interesting market with great potential due to its European identity, its territorial proximity, and its links with Islamic countries, as well as favorable conditions for foreign investment and its own industrialization.

The Turkish aerospace industry took a major step forward on 6 March, when Prime Minister Turgut Ozal inaugurated new plants in the Murted area. Parts for the F-16 are already being produced here. In addition, the Ankara government and General Dynamics signed an agreement for a series of industrial compensations valued at $480 million, and the establishment of a company (with $35 million in capital) to invest in further compensation initiatives. AIR PRESS recalls that this is part of a program that will involve $4.2 billion in American investment.

Fourteen locally-assembled F-16's have come out of the Murted plants so far; this will reach 26 by the end of the year. By 1994, 101 rear fuselage sections, 80 central fuselage sections, and 69 wings will be produced in Turkey for export to General Electric in the United States, in addition to the components produced for 152 F-16's which remain to complete the Turkish Air Force's order (160 units). The ratio of locally-produced parts will eventually reach 70%. AIR PRESS notes that Turkish Defense Minister Ercan Vuralhan stated that they will manufacture the more advanced versions of the F-16, even for export. AIR PRESS observes that the remark about "more advanced versions" could refer to possible Turkish participation in the "Agile Falcon" program. The search for a partner in this program was frustrated in Europe by Belgium's withdrawal to equip itself with new-generation aircraft. This led General Dynamics to look in other directions, and it seems to be doing well in contacts made with South Korean firms.

Italian-French Satellite, Future Launch Described

MI890183 Rome AIR PRESS in Italian 19 Mar 89 pp 378-380

[Text] "Even the Americans envy us. Some years ago, NASA was still skeptical about the possibility of developing the Hipparcos satellite,—and today we are considered one of the leading world experts in astrometry. Even the Soviets, who are developing a similar satellite, have asked us for advice." These statements were made by representatives of ESA [European Space Agency] and by the Matra and Aeritalia engineers who have worked side by side on Hipparcos (High Precision Parallax Collecting Satellite) for the last 7 years. The satellite was presented to the Italian and foreign press on 1 March at Aeritalia's space systems division in Turin. Hipparcos (from the name of the Greek astronomer who lived around 120 B.C.), AIR PRESS notes, is a space experiment for the accurate measurement of the position, parallax, and motion of the stars.

Opening the press conference, Prof Roger Maurice Bonner, director of ESA's scientific programs, pointed out that the idea for Hipparcos was first formulated in 1966. A great deal of work and imaginative thinking was needed to translate this idea into reality and to have it accepted as part of a European project by the European Space Agency. Originally proposed to the CNES [French

National Center for Space Studies] by the project coordinator, Prof Pierre Lacroute, an expert in astronomical calculation from the Strasbourg Observatory, the initial study concluded that the technologies available at the time were not sufficient to achieve the objectives. Some years later, in 1974, the project was submitted to ESA which decided to carry out a study after which Matra received the contract for the scientific instrumentation and Aeritalia, for the platform.

The speech given by Eng H. Hassan, director of the project, focused on industrial aspects. According to AIR PRESS, Hassan stated that Hipparcos is about 1 year behind schedule. The satellite was in fact ready to be launched in mid-1988, but was postponed because of a decision to use Ariane 4 for the launch instead of Ariane 3. The launch of Hipparcos into a geostationary orbit at 36,000 km is now scheduled for 29 June, with a possible delay of a few days (until mid-July at the latest) if problems arise. AIR PRESS reports that the satellite, which has completed integration tests in Turin, was presented to the press without certain external structural elements and without solar panels, as it was waiting for the final checks to be performed. It will be transferred to Matra Toulouse very shortly; this will be followed by a period of recommissioning at the Darmstadt center. After this, the satellite will be transported to the Kourou Space Center in Guyana for launching. Hipparcos (which weighs 1,140 kg) will remain in orbit for approximately 2 and ½ years.

Eng S. Vaghi of ESA-ESTEC (ESTEC is the organization responsible for coordinating the program's technical staff), who spoke in the place of M. Perryman, discussed the scientific aspects of the mission. The satellite is being launched into space to obtain more accurate measurements, because the atmosphere acts as a filter in measurements taken from the earth, and since earth observatories can observe only a part of the celestial body, possibilities exist for systematic errors. On the other hand, the satellite will have a full view of the heavens, there will be no atmosphere to create disturbances, the instruments remain stable in the absence of gravity, and the satellite will operate in a stable thermal environment. Vaghi emphasized that Hipparcos will enable us to obtain more accurate data on the dynamics of the solar system, the rotation of the galaxies, and the structure and evolution of the stars. We will be able to carry out about 100 photometric observations for each of the stars we examine during the mission.

Additional interesting scientific data was provided by Eng M. Bouffard of Matra, who highlighted the industrial commitment (7 years of work by 31 companies in 11 countries and three scientific institutes), involving 1,500 man-years of work and a total of 400 people in the most demanding and difficult phases of the project such as the production of the reflectors. These are unique because of their extremely high-precision finishing. Eng B. Strim of Aeritalia briefly described the work of this Italian aerospace company which, in addition to supplying the platform structure's subunits, was responsible for satellite integration, testing, and level testing. The Aeritalia Group developed approximately 30 test procedures for the satellite, a total of about 600 specific sequences for step-by-step testing of Hipparcos to demonstrate that all the satellite's functions are performed correctly. As AIR PRESS recalls, the testing of Hipparcos included testing for electromagnetic compatibility, dynamic testing, and checking of the thermal balance. The results of the tests on the electric and flight models of Hipparcos made it possible for Aeritalia's integration division to increase its knowledge of how the satellite functions in the various operating conditions of the mission and how to prevent anomalies of all kinds. The satellite's payload is composed of a Schmidt-type reflecting telescope equipped with accessories, a modulating mesh, and a light detector. Aeritalia has devoted approximately 170,000 man-hours to preparing Hipparcos for its mission. The work was definitely demanding, but the know-how acquired will enable the personnel to deal with future problems with greater expertise and confidence.

F. Donati and R. Grenon also spoke. Donati stated that the objective of the mission is to increase our knowledge of 120,000 stars with a precision of 2/100ths of a second of arc, a precision that on earth would correspond to 5-10 centimeters over distances as great as thousands of kilometers. In essence, the satellite will transmit to earth approximately 200 billion photon counts which will be used to obtain accurate measurements of each star. Rather than being stored on-board, the data collected by Hipparcos will be transmitted immediately to earth. The ESOC [European Space Operations Center] at Darmstadt will collect the data from three of the ESA tracking stations and will provide real-time control of the critical operations. The data will be recorded at a rate of 24,000 bits per second, a task which ESA has assigned to FAST [Federation of Scientific and Technological Associations] and DNAC in view of the importance and tremendous complexity of the processing involved. These two consortia have worked with the companies for 6 years and are now waiting to begin counting so they can produce a single catalog of the stars by 1995. This initial cataloging of approximately 120,000 stars will be followed by a second cataloging of an additional 400,000 stars (Tycho mission). Grenon, on the other hand, discussed astronomers' expectations for the mission. Hipparcos will be able to provide useful information on the internal structure of less distant stars, on measurements of stellar density, and on the dynamics of the galaxies. Knowledge of the galaxy rotation curve will make it possible to determine the density of the galaxies themselves, as well as to compare the number of the stars and consequently to determine their gravitational mass.

Despite the succinct presentation in Turin of the industrial and scientific aspects, the discussion covered a number of interesting details. How much will this satellite cost? Aeritalia has confirmed a figure of approximately 300 billion lire to AIR PRESS, 160 billion of which will be contributed by Italian industry (50 billion

by Aeritalia alone and 110 billion by subcontractors), and the other 140 billion by Matra. A considerable sum, certainly, but a great added value as well, or to use Hassan's words: "The catalog that will be produced thanks to Hipparcos will be used by astronomers for decades to come to add to our knowledge of the universe, thus demonstrating to future generations the importance of European cooperation in space."

Italy: Technical Specifications of "Grifo" Radar Discussed

MI890211 Rome AIR PRESS in Italian 8 Mar 89 pp 426-427

[Text] Aeritalia and Aermacchi recently signed an agreement with FIAR to complete the development of the "Grifo" radar in the ASV (Anti-Ship Variant) configuration, suitable for installation on AMX aircraft.

The P-2801 "Grifo" ASV (previously known as "Grifetto") is the first to be developed of the three "Grifo" family modular avionic radars that operate in the X-band. FIAR has invested approximately 50 billion lire of its own funds in the project since 1985, when the Integrated Group responsible for development of the AMX provided information on a prospective antiship use of the aircraft. The development of the radar and cell interface was pursued with the cooperation of Aeritalia (prime contractor for this Italian-Brazilian program). A civilian Piaggio PD-808 twin-engined jet with a "Grifo" ASV on board was used for the first flight tests. Installation on AMX aircraft requires only a slight elongation of the aircraft nose; this is achieved by inserting an additional frame without altering the size of the "radome."

This "Grifo" ASV's overall dimensions, power consumption (1 KVA), and weight (53 Kg, compared to 90 Kg for the first member of the family, the P-2800, which cost about twice as much as the "Grifo"), make it extremely suitable for a relatively small and lightweight aircraft such as the AMX, for which it was made to measure. However this does not make it less suitable for installation on other types of aircraft in the same class.

The "Grifo" radar's performance meets the operational requirements established for the antiship version of the AMX class, and although optimized for that application, its modular design makes it possible to expand its existing, but limited, functions and to add new ones if required. In the air-sea mode it has a range of approximately 65 nautical miles and can operate in configuration with the launching of antiship missiles in the "fire and forget" class; it can carry out the functions of mapping the area over which it flies, terrain avoidance, freeze, and beacon.

In the air-air mode, currently limited to the necessary actions for self-defense with missiles such as the "Sidewinder," the radar range is approximately 20 nautical miles and possible functions include search/tracking "look up," aerial combat, and air-air telemetry. As mentioned earlier, the radar system displays a number of other, more limited functions (for example, in the presence of "clutter") which can be expanded if and when required by the operator.

The modular design will permit the development of a "coherent" version (similar to the other two radars in the family) by simply replacing the transmitter, modifying some receiver parts, and adding the doppler filtering.

Technology used for all the radars of this family (which includes the P-2803 "Grifo" X, an intermediate model between the P-2800 and the P-2801) is similar to technology developed by FIAR for its participation in ECR-90, the European radar proposed for the EFA program by the consortium in which the Milan-based company participates (regardless of the radar model that is selected, FIAR has been appointed prime contractor for Italy). The development of this new radar family benefits from the company's experience in the field of avionic radars, in which FIAR is the leader in Italy. The "Grifo" ASV is expected to be extremely reliable from a technical point of view (estimated MTFB—Mean Time For Breakdowns—is 250 hours) and will be manufactured entirely in Italy (the only component developed abroad is the transmitter, a 100 kw magnetron oscillator which nevertheless can be produced in Italy).

SNIA BPD's Defense, Space Programs Described

MI890207 Rome AIR PRESS in Italian 10 Mar 89 p 415

[Text] On 7 March, Gen Franco Pisano and officers of the General Staff met at the Palazzo Aeronautica with officials of the BPD Difesa e Spazio company. Marco Pittaluga, head of this group and managing director of SNIA BPD, and his colleagues described the diversified industrial activities of the company, which is controlled by the SNIA BPD group. Emphasis was placed on the programs of specific interest to the Armed Forces including, AIR PRESS reveals, space-related projects.

Two projects developed within CASMU (Consortium for Dispensable Multipurpose Weapons) were discussed in relation to the company's defense division: the MSOW (Modular Stand Off Weapon), an international program for the development of an air-to-ground weapons system with long-distance launch capabilities, and the Skyshark gliding, non-propelled cluster bomb.

The space division's involvement in various developments were also described. These include MAGE type apogee motors, the IRIS perigee motor, motors for stage separation, solid-propellant boosters for the European Ariane launchers, propulsion systems for the Eureca retrievable platform, for Italsat and Olympus telecommunication satellites, for the Tethered scientific satellite, and for elements of the European Colombus space station, as well as the development of electric magnetoplasma and arc jet engine propulsion systems. The officials of BPD Difesa e Spazio also described the Scout

II launcher program which is currently being studied by their company and the U.S. firm LTV; this program will make it possible to double the launch capacity of the well-known Scout launcher in low orbit.

Concluding his speech, Gen Pisano underlined the high standards of quality reached by BPD Difesa e Spazio, a leading European company in the area of solid-propellant space propulsion and one of the major European manufacturers of defense weapon systems. Pisano confirmed that the Air Force is interested in a more active participation in the development of Italian space activities, particularly in the management of the San Marco equatorial polygon in Kenya. In this context, Gen Pisano emphasized that the development of the Scout II launcher is of crucial importance for the country's future launch requirements.

AUTOMOTIVE INDUSTRY

Automation Increases Fiat Productivity

36980174b Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 24 Feb 89 p 2

[Article by Harald Jung: "Fiat Leads European Automobile Manufacturers: Company Has Made Great Deal of Progress in Automation Technology"]

[Text] Italian automobile manufacturers can be more than satisfied: With a total of 1,325,405 vehicles delivered last year, they accounted for around 60.6 percent of domestic demand. In the boom month of December 1988, they even achieved a market share of nearly 64 percent.

The upswing in the automotive industry, which has been under way for several years now, benefited foreign manufacturers to nearly the same degree; the Italian market, including domestic makes, absorbed a total of around 2.18 million vehicles. This means an increase of more than 10.5 percent compared to 1987, when a growth rate of more than 8.3 percent was achieved against the previous year. Calculated for December alone, a comparison of figures with the previous year yields growth of as much as 30 percent, a boom in demand that has not been seen in 5 years.

Increasingly, automobile production in Italy means Fiat, recently reinforced by the takeover of Alfa Romeo 2 years ago. Last summer, after the death of Enzo Ferrari, his highly-regarded automobile works finally fell to Fiat as well. During 1988, the Turin automotive conglomerate was able to sell around 1.3 million vehicles, an increase of a full 129,000 units over the previous year. This corresponds to exactly 59.95 percent of domestic demand. Growth was recorded for all three company makes: Fiat at 10.6 percent, with 955,823 new car registrations, Lancia at 5.8 percent, with 210,551, and Alfa at 21.6 percent, with 142,106. The Fiat "Uno"—the 1984 Car of the Year—alone achieved sales of 374,853 for the gasoline model, 64,291 for the diesel model, while 212,643 Pandas were sold (more than 2 million manufactured since 1980). Sales of the "Tipo," the new Fiat showpiece and "1989 Car of the Year," achieved a level of 217,414 units for gasoline and 48,179 for diesel.

Alfa's new flagship, the 164, which is available in Italy in four engine models, has thus far found around 33,000 customers in its home country alone. Production at the Arese plant is currently in full swing, at a level of around 250 vehicles a day. Between 5,000 and 6,000 units are to be sold in the United States and Canada this year as a result of a marketing agreement with Chrysler.

At home, the Italians feel German competition primarily in the form of Volkswagen (138,991 vehicles, or a 6.36 percent market share) and Audi (44,604 units, or 2.04 percent of the market). From the French, it is Renault with 154,953 vehicles (7.09 percent) and Peugeot with, for the first time, 97,918 units (4.48 percent) during the 12 months of 1988.

Competition from the Japanese, of which there is so much across the continent, has thus far proven to be insignificant in Italy. Import quotas currently limit their presence to 17,000 vehicles a year. These are primarily off-road vehicles, a market that is enjoying increasing popularity. The only current production facility of Japanese origin is the Daihatsu plant with an annual capacity of around 4,000 vehicles.

In terms of value, passenger automobile sales by Fiat last year was reflected in a total turnover of 21 trillion lire. This corresponds to approximately 47 percent of total group earnings and a sector-wide positive contribution to the Italian trade balance of 7.3 trillion lire. Agnelli's empire currently comprises more than 700 companies and 1.2 million employees, approximately 60,000 of which are abroad. Around 50,000 employees are distributed among the 29 production operations in the southern part of the country alone. In Mezzogiorno, there is now a fixed asset investment of the equivalent of $4.2 billion.

Together with its various suppliers, Fiat has become one of the country's most important regional economic factors (accounting for 40 percent of all jobs in Campania, for example). This includes especially the plants in Cassino (Tipo assembly), Termoli (Fire engines), Foggia (Iveco) and Pomigliano (Alfa 33, Lancia Y 10). Until recently, the latter was considered one of the most controversial production facilities in the world, because it operated under a heavy deficit. At the plant of the former "Alfa Sud," an average of 838 vehicles are now assembled each day, compared to only 540 in 1987. This growth was accompanied by the creation of 1,470 new jobs, together with economy measures and early retirements.

In the meantime, Alfa Romeo, formerly a company held by the state-owned Iri group and since the takeover by Fiat known as Alfa-Lancia, is considered to be largely rehabilitated. This also applies to the assembly plants in Arese, near Milan, where the 75/90 as well as the 164 (known internally as "Tipo 4") are produced. Three trillion lire are earmarked for investment through 1992, added to the 500 billion already put in. Through the acquisition of Alfa Romeo, Fiat is also able to fully enter into the upper segment of the market, the production branch with the highest profit margin, in which it now has a 70 percent share, compared to the previous 12 percent.

Another motive for the buyout in the fall of 1986 was the prestige of the cross-viper emblem, which attracts enthusiasts from all over the world.

The persistent growth in Fiat competitiveness, as well as its increasing success on the market can be attributed first and foremost to the application of modern production technologies and a consistent model policy. The best example of this is the plant in Cassino, near Naples, which is considered the most advanced of its type in Europe. There, the successful "Tipo" model has been assembled since early 1988 on highly automated, flexible production lines. The 403 robots for welding, screwing, manipulating, painting, burring and testing, 49 control cameras, 24 laser beam generators, 8 large computers and 5 automated test stations, in conjunction with 1,239 self-propelling and remote-controlled cars provide for a well-refined economy of labor.

For example, the installation of the front and rear wheel suspension, the dashboard, the seats, the bumpers and the wheels is all fully automated. Using laser beams, MAC stations check a total of 7,800 measurement points on the car body, 70 percent of which is hot-galvanized. The goal is zero-defect production of the model, designed using modern CAD/CAE technology; 300 samples from the preliminary series were subjected to the hardest tests in everyday operation throughout Europe before the Tipo was licensed for sale. Even the tailgates, fuel tanks and bumpers are manufactured in house.

Thus, Cassino features the world's first plant for producing car doors made of thermosetting plastic, up to 1,800 units of which are manufactured each day for large-scale production, including for other users. With the Tipo, Fiat hopes to take over around 10 percent of market segment C, which in Europe constitutes approximately 30 percent of auto sales. Its current daily production is around 1,900 vehicles.

One of the main actors in the economy and profit-promoting measures is the Robotgate system used by Fiat, which permits flexible production of Tipo and Regata in the station wagon model as well. This process, developed by the "Comau" subsidiary, has already been sold to 14 other automobile manufacturers in 13 different countries. Among the latest foreign delivery orders are the 10 billion-lire deal with the British "Venture Pressing Limited" (GKN and Jaguar) and the $39 billion agreement for equipping the automotive plant in Gorki, the largest in the USSR. Another agreement was recently reached with the German "Trumf," another leading European manufacturer of machine tools, on joint production of laser robots.

Fiat made a name for itself in the area of automation 4 years ago when the "Termoli 3" production facility began operations. In the coastal town of the same name on the southern Adriatic Sea, the so-called Fire engines (the acronym stands for "fully integrated robotized engine") has been produced since 1985 in the 1,000- and 1,100-ccm version for the Uno and the Y 10. Today, this facility continues to feature the world's highest level of automation in engine production (80 percent). According to plant management, the number of warranty claims has been reduced by one-quarter, compared to the traditionally assembled 903-cc engine. Beginning in 1990, classes of engines with even larger capacities are to be produced using the Fire principle. The Turin family company has spent around $770 million on quality research over the last 3 years, as well as hiring 600 new workers for that task.

Turin's mammoth conglomerate wants to expand its total worldwide sales to 50 trillion lire by 1992, the year of the great common market. According to Fiat head Agnelli, there will only be four or five auto manufacturers in Europe by then. It is thus time to look around for strong allies. The share of automobile production (passenger and commercial vehicles) at Fiat will have dropped from 72 to 60 percent of total sales, Agnelli believes, while other sectors, such as aircraft construction, telecommunications, automation technology and aerospace technology will have made significant gains.

COMPUTERS

French, FRG, British Research in Neural Computing Examined

Thomson-CSF

36980195 London PROCEEDINGS OF THE SECOND EUROPEAN SEMINAR ON NEURAL COMPUTING in English 16-17 Feb 89 pp 1-6

[Text] 1. INTRODUCTION

THOMSON-CSF is making one of the largest commitments to neural computing of any company in Europe. The main reason for this effort is the important improvements in image processing and signal processing expected from neural networks approaches. These problems are crucial for many equipments (radars, sonars, infra-red cameras...) being developed in THOMSON-CSF.

The main interests in the neural networks techniques are the following:

- The algorithms are intrinsically massively parallel. Design of dedicated massively parallel hardware let expect a high level of performance, which is especially important for the real-time applications interesting THOMSON.

- Learning form examples is possible. This is particularly important in signal processing where huge databases coming either from real measures, or from simulations, are available in the Company.

- The algorithms are made with a combination of very simple basic models; this allows data fusion and combination of existing algorithms and new ones.

- Fiability and resistance to failures is another important aspect, as well in the military applications as in the consumer electronics products.

2. APPLICATIONS DOMAINS

Several military applications are being studied. We can quote:

- Classification of sonar signals (recognition of sources of emission, noises discrimination, identification of mines

- Localisation of a source of sonar

- Radar target recognizer

- Identification of radars (counter-measures)

- Radar and infra-red targets and tracks acquisition

- Correlation between infra-red images taken from a plane and geographic maps databases

Some other applications have also been made, most often to learn how to master new algorithms:

- Automatic reading of printed documents

- Recognition of handwritten characters

-Identification of fingerprints

-Travelling salesman

-Conversion from numeric data to symbolic data

-Non-linear prediction of temporal signals

3. STUDIES ON ALGORITHMS AND HARDWARE IMPLEMENTATIONS

Formal studies on algorithms performances and hardware architectures are being made:

- Formal studies on the classification of linearly separable boolean functions

- Comparison of performances of various classification algorithms (neural and non-neural ones)

- Pattern recognition on video images using optical holographic systems

- Realisation of an Analogic Neural Network in discrete components for a 1024 neurons of 1 bit totally connected network (IRENE)

- Studies on integration on one chip of 1000 totally interconnected neurons, using ferro-electric technology

4. PYGMALION

THOMSON is the leader of the Esprit II project Pygmalion.

The partners of the project are:

- INDUSTRIAL PARTNERS:

THOMSON-CSF	(France)	MAIN CONTRACTOR
PHILIPS	(Netherlands)	
S.E.L. (ALCATEL)	(Germany)	
C.S.E.L.T. (OLIVETTI)	(Italy)	

-UNIVERSITIES:

UNIVERSITY COLLEGE OF LONDON	(England)
INESC	(Portugal)
UNIVERSITY OF MADRID	(Spain)
CTI	(Greece)
ECOLE NORMALE SUPERIEURE	(France)
UNIVERSITE PARIS V	(France)

The project will last 2 years. It is a 35 man-years project, with funding of 5 M Ecus

The first tasks are in software

- Definition of neural network dedicated language:

- European standard
- High-level and object-oriented (reusability)
- Intermediate level format (portability)

- Realisation of compilers:

- Into C for sequential machines
- Into OCCAM for transputer-based workstation

- Definition of a graphical environment:

- Interactive control of simulation
- Access to Algorithm parameters
- Various graphical display of simulation

- Development of a library of reusable algorithms in the dedicated language

The second focus of the project is application

The goal is to show convincing results in 18 months.

Three promising application domains have been selected:

- Image processing:

- Segmentation (edge detection, texture analysis)
- Stereovision
- Classification and pattern recognition
- 3-D object recognition
- Evaluation and comparison with non-neural approaches

- Speech recognition:

- Speaker adaptive independent word recognition for medium-sized vocabulary in office environment
- Independent word recognition in telecommunications environment
- Low-level speech processing (recognition of phonems)
- Coarticulation and subword units

- Noise recognition:

- Classification of underwater noises

Siemens

36980195 London PROCEEDINGS OF THE SECOND EUROPEAN SEMINAR ON NEURAL COMPUTING in English 16-17 Feb 89 pp 7-15

[Text] Abstract

If today's expectations for neural networks prove realistic, neural nets will soon find their way into information technology systems. Siemens will then be challenged to make the best use of this innovation, both as a systems house as well as a user of information technology. In order to achieve broad R&D competence in the field of neural networks, Siemens Corporate Research and Development has launched a 3-year project which aims at providing the hardware and software environment necessary to run large neural networks applied to various problems in industrial scene analysis.

1. Introduction

Inspired by the functioning of human perception, artificial neural networks (ANNs) have been introduced as highly connected networks of elementary processing elements. They exhibit basic characteristics of human perception such as massively parallel information processing, the capability of adapting themselves to specific tasks, and robustness. These properties correspond to principal weaknesses of conventional information processing. Therefore the new field of neuro-computing has drawn enormous scientific and commercial attention to its activities and is expected to augment conventional computing with an important new paradigm.

The ability of ANNs to reveal structures hidden in data makes them particularly well suited for tasks in pattern recognition, diagnosis and prediction. Furthermore, the capability of ANNs to provide computational power in parallel appears to offer new ways of dealing with hard combinatorial problems such as those occurring in placement and routing of electronic components or in planning and decision making.

Within only a few years, the neural net paradigm has initiated a field of unusual breadth and dynamics. If today's expectations for ANNs prove realistic, neural nets will soon find their way into information processing systems. Siemens will then be challenged to make the best use of this innovation, both as a systems house and as a user of information technology. Thus, neural nets will need to be integrated into the hardware and software environment of the company.

Siemens Corporate Research and Development therefore decided to launch a 3-year "Neurodemonstrator" project to integrate and extend previous activities in the field of neural nets. The project started October 1988, and the total manpower involved will be approximately 60 MY.

The project aims at evaluating the potential of neural nets for information technology by setting up a system which combines conventional and neural approaches to industrial scene recognition. Methods, principles and procedures for the design and analysis of ANNs are to be studied and developed under the real-world constraints of the application. Application-specific requirements must be translated into network characteristics. On the software/hardware side, both a simulator including a comfortable user interface and a co-processor for fast emulation of neural nets will be provided. The project is accompanied by research on the technological aspects of ANNs.

As the U.S. research labs still appear to be the main innovators in this field, we will maintain close ties with them through our research group at RTL, personal contacts, and cooperation with leading American universities.

We intend to participate in the national "Information processing in neural architecture" project; by contributing to the Jessi study "Microelectronics for Artificial Neural Nets," we have expressed our interest in cooperation concerning the technological aspects of ANNs; we are open to any kind of cooperation which is compatible with the overall goal of the project.

The project currently engages some 20 researchers. Their experience in pattern recognition, artificial intelligence, software techniques, computer architecture and circuit design is the key for having the project provide reliable statements about the medium-term potential of ANNs for information technology.

The following sections summarize the subtasks of the project. There is no conclusions section and no list of references.

2. Design and Analysis of Neural Networks

The design of a neural net requires transforming the structure of a problem into the topological-functional structure of a net that solves the problem in a highly parallel fashion. This mapping is achieved by fixing a connectivity structure, defining input/output nodes and choosing net parameters such as weights, thresholds, activation functions and time-scales.

In the simplest case, one explicitly extracts the topology and parameters for a suitable net from the problem. Various optimization problems such as travelling salesman or associative access can be coded into quadratic (or higher order) forms, defining a Hopfield net or a Boltzmann machine, which solves the task. It is the massive parallelism that neural nets focus on such problems that appears promising and deserves attention within the project.

In the most difficult case, the structure of a problem is entirely hidden in the data and the learning must reveal this structure and synthesize a net. We are currently experimenting with time series derived from bio-signals and economic data. Under certain application- specific hypotheses the results obtained so far are encouraging.

Both theory and practice confirm, however, that unrestricted learning is costly. In order to remove part of the burden from the learning routine, explicitly known information about the structure of the problem should be used to construct the coarse structure of the network. A problem of this type is pattern recognition subject to certain invariance properties. Such invariances induce relations between net parameters, thereby reducing the number of "free" parameters.

We are currently implementing such knowledge into the learning routines of various models. It is in this spirit that we expect one might bridge the gap between the symbolic and the connectionist approach to AI.

We are also exploring another approach to solving pattern recognition problems under invariance constraints, in which a vector of geometrical features is extracted from a pattern and then fed to a neural net for recognition.

The prominent feature of the Hopfield net is the existence of a cost function—determined by weights and thresholds—on the state space of the net. This function controls the net dynamics such that alterations in the state of the net only come about in a "cost reducing" manner. In particular, stability is ensured this way.

An underlying basic assumption in the Hopfield net as well as in the other dynamically stable networks employed so far is that of a symmetric connection matrix. We have shown that stability is preserved under more general conditions. Initial results indicate that our generalization is more efficient for pattern association than continuous Hopfield, Cohen- Grossberg, and Kosko nets.

An important goal of network design will be the development of a methodology which—as in circuit design—allows nets to be hierarchically specified and composed from subsets. For simple binary nets we are experimenting with an extended Prolog as an executable net specification language. Extended Prolog (PROLOG-XT) was developed in our laboratories as a tool for circuit design; it symbolically processes threshold logic.

On the basis of a C-library containing a variety of ANN-algorithms and models, we are developing a network simulator; the targeted release data for a pilot version is December 1989. In a later stage of the project we will need techniques for observing network dynamics that go beyond panning and zooming.

One might have to abandon the microscopic picture of individual nodes and weights and switch to macroscopic descriptions of the network's behavior by calculating, e.g., moments of distribution functions for the nodes and weights.

3. Neural Nets for Industrial Scene Analysis

The choice of image processing and scene analysis in particular as an application domain for the project "Neurodemonstrator" was motivated by three reasons:

- The application in question should be of vital interest to various groups within the company. Furthermore, it should indicate possible extensions or improvements of the current product spectrum. Therefore, the application must not be too specific and permit generalization.

- Our domain-specific know how should be extensively utilized in order to achieve synergetic effects between conventional and neural approaches and thus make it possible to critically evaluate and compare the ANN results.

- The full scale of properties of neural nets, e.g., massive parallelism, adaptability, and robustness, should be exploited within the application example.

Within the large field of industrial scene analysis we will concentrate on the recognition of industrial work pieces. This comprises identification of the parts and their precise position and orientation, as well as recognition of details such as stamped characters. The task can be extended to more complex problems, e.g., stereo vision, merging views under various perspectives, or integrating different types of sensors. Actively directing the camera or a gripping device extends the problem to robotics, where loopback between image processing and control mechanisms has to be performed in real-time.

The image processing task comprises preprocessing, extraction of characteristic features, segmentation of regions of interest and individual objects, and classification of the corresponding structures. This must be solved within certain limits independently of illumination, distance of the camera, and position or orientation of the objects. Apart from these invariances, graceful degradation in the case of incomplete or missing information is required.

An important point is the concept of an adequately pre-structured network which permits the integration of conventional procedures and knowledge-based AI methods. We will study the appropriate design of individual components (subnets) and their structural relationship. Several types of hierarchical structures will be considered. Context information and other constraints from higher levels of the hierarchy must be taken into account at the lower processing levels. The necessary feedback and relaxation processes can be realized with neural techniques and may lead to qualitatively improved solutions.

We have already acquired considerable experience in the major fields of pattern recognition: speech and vision. In both domains, after appropriate preprocessing, characteristic patterns are derived. Therefore, knowledge from both areas can be adapted to the problems at hand.

Early research concentrated on the problem of clustering for vector quantization. For this task, Kohonen's method of self-organizing maps was successfully applied to both a set of short-time features from speech and segments from image sequences.

For the classification of pre-segmented signals (isolated words as well as characters stamped on industrial work pieces), several neural approaches were considered. In the case of binary features which were derived by thresholding grey-level pictures, a Hopfield net was able to associate the correct references even from heavily distorted input patterns. For problems requiring non-binary input, multi-layer perceptron models were examined. Here, questions of suitable structures for network hierarchies were studied. Compared to standard pattern matching approaches, a superior performance of suitably structured networks could be demonstrated.

In addition, work is in progress to use pre-structured perceptrons for the task of line extraction from a preprocessed image. This approach will explore and emphasize the possibilities of feature extraction by neural structures.

As a related approach to the commonly used extended perceptron models, Fukushima's Neocognitron was considered. The ability of selective attention, which is provided by this model, may especially help to reduce the problem of the careful segmentation of individual objects within an image.

4. Advanced CMOS Design of Neural Networks

The response and the characteristics of present models of artificial neural nets are primarily investigated by simulation on vector computers, workstations, special coprocessors or transputer arrays. The fundamental drawback of such simulators is that the spatio-temporal parallelism in the processing of information that is inherent to the neural net is lost entirely or partly and that the computing time of the simulated net, especially for large associations of neurons (tailored to application-relevant tasks), grows to such orders of magnitude that a speedy acquisition of "neural" know-how is hindered or made impossible.

An appreciable reduction in computing time, and thus the handling of largish tasks or those that are to be executed in realtime, becomes possible with neural hardware. In contrast to simulators, it contains an artificial neural net of finite size: neural parallelism is hardware-implemented. Apart from the shortest possible computing time, neural hardware offers a very much smaller structural volume than can be implemented with hardware simulators for the same task. This aspect is especially important when neural hardware is to be incorporated in terminals for man/machine communication or mobile robotics.

Neural nets can be specified for tasks in low-level through to high- level pattern recognition and processing. Characteristic of the high- level application (in comparison to low level) is the very much higher amount of information contained per bit. This expresses itself in a comparatively small number of neurons needed to manage a high-level pattern recognition problem. A "one chip" implementation becomes possible. Also, the low number of neurons enable a short simulation time for the learning phase with the result that the task is well defined and the hardware can be matched optimally to the task. Furthermore, the weights can be determined by simulation, so that the learning algorithm does not have to be implemented in hardware. In high-level pattern processing there is thus the possibility of application-specific neural chips with programmable weights, provided that submicron technology is accessible.

Neural nets for low-level tasks or applications requiring the combined action of diverse neural nets, on the other hand, overtax the single- chip integration potential of present technology, as well as that of 0.3-um technology, by whole orders of magnitude. Such applications can only be implemented as multichip systems. The size of such a net will not permit simulation (especially of the learning phase) within a reasonable period of time and therefore the weights cannot be determined by simulation, which means that it is essential for the learning algorithm to be implemented in hardware.

In the development of neuro-computers for artificial neural nets it is consequently a matter of implementing the compute-bound learning algorithms in hardware and designing a system and circuit architecture that simulates in optimal fashion the massive parallel networking of the neural net and produces a sufficient measure of flexibility and expansion capacity for coping with a wide domain of applications (e.g. robotics).

The basic idea of our approach to neuro-computer design is to generate a large net by means of a systolic array of small (chip-integrable) nets. An implementation of this kind has the spatio-temporal parallelism for the modules of the array and still allows the spatially parallel, time- sequential processing of the neural input. Systolic emulation with small nets seems to be the best possible approximation to massive parallelism and is thus also best suited for rapid execution of the learning phase of large neural nets.

The study "Microelectronics for Artificial Neural Nets" (VDI Press, Dusseldorf, F.R. Germany), which relies mainly on the work of SIEMENS researchers, pursues the question of what implementation potential is already available in advanced CMOS technology for artificial neural nets. There, the application-specific and system-relevant influences on the development of neural hardware are discussed, as are problem areas of circuit engineering and technology.

5. Neural Networks Based on Amorphous Silicon

The field of large-area electronics was stimulated in the seventies by the introduction of a new material, hydrogenated amorphous silicon (a- Si:H). This thin-film material combines the capability of large-area manufacturing with almost the full range of semiconductor virtues, as well as optimum structural uniformity and moderate processing temperatures. In addition to its use for solar cells, the main applications of amorphous silicon are currently large-size linear image sensors and flat-panel displays. Major components are thin-film photoelements and thin-film transistors.

Amorphous silicon technology offers properties which are very favorable for the hardware realization of neural networks. First of all, in contrast to crystalline silicon (c-Si) with its limited area, a-Si:H can be deposited on surfaces of practically any size. Therefore upscaling of neural networks is almost unlimited. The number of process steps is smaller by nearly an order of magnitude compared with c-Si. Typically only 4 to 6 layers have to be processed for large-area devices. Like sensors or displays transmitting optical information, which have to meet the high uniformity standard set by human visual perception, neural networks also have stringent precision requirements. These can easily be realized, as in a-Si:h technology the processes are applied to the whole substrate area in a very homogeneous manner. Therefore, large- area devices like image sensors or displays show excellent uniformity. The highly parallel structure of a neural network requires weak interconnections (in the megaohm range) to limit the total current consumption of the network. Such weak connections are very difficult to obtain in conventional c-Si technology. a-Si:H thin-film components will solve this problem. As a-Si:H technology has proved to be fully compatible with c-Si technology, such a connection matrix could also be formed on top of a c-Si neural chip in a hybrid technology. In contrast to microelectronics, the thin-film technology of large-area electronics allows multilayer techniques common to pc-boards to be used and thus the wiring problem typical of neural networks to be solved.

Altogether, a-Si:H has the potential for an innovative thin-film implementation of neural networks. Inverter circuits allowing the discriminator function of a neuron to be implemented have already been formed with a-Si:H thin-film transistors. With thin-film photoelements as weights, an optically programmable neural network could be created. Such photoelements are continuously programmable and therefore exhibit full analog depth. Using a 10" x 10" substrate, for example, a large array of the order of 10^5 synaptic elements could be fabricated. Neural networks of this size can hardly be realized in conventional c-Si technology in the near future.

An outstanding application potential of amorphous silicon technology for neural networks lies in the large-area integration of image sensors and analog neural networks. This obviates the troublesome interface problem between network and sensor elements.

6. Acknowledgements

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British Telecom

36980195 London PROCEEDINGS OF THE SECOND EUROPEAN SEMINAR ON NEURAL COMPUTING in English 16-17 Feb 89 pp 16-23

[Article by Dr. Charles Nightingale. Words in italics as published.]

[Text] 1. INTRODUCTION

Last year British Telecom Research Laboratories at Martlesham launched a five-year project to study Connectionist solutions to a number of difficult problems in Vision, Speech, Natural Language and Knowledge Based Systems.

BT undertakes some research projects of a longer term nature, but usually in areas where applications for the successful outcome of the research can be envisaged. Since BT is a leading international telecommunications group it has a strong interest in any enhancements that can be made to the communication process. Some of the main current difficulties in the field are in programming machines to have some human-like abilities in speech recognition, language understanding and picture interpretation. These are areas in which Von Neumann computers using rule-based systems have not been uniformly successful. For this reason the Connectionist project (CONNEX) was set up early last year.

2. TEXT PROBLEMS

Given its interest in some concrete applications the CONNEX project has generated a number of Test Problems which are intended to ensure that Neural Nets which are developed will be constantly tested against problems which will relate to the ultimate applications for which they are intended.

Some of the Test Problems and the applications to which they are intended to relate are described below. Those on vision are given in some detail to give an idea of the form the test problems will take; those on speech are summarised, and some mention is made of other problems under consideration in Natural Language and Knowledge-Based Systems. The Test Problems have already been described to a number of university researchers and comments made by them have led to some modifications. In particular the visual feature identification problems have been extended, both by the production of more difficult data and by making the goal more demanding.

CONNEX is considering conditions upon which the test data may be released for use by universities in research in connectionism.

In addition to the two original sequences, further sequences will be made available which have been contaminated by Gaussian noise.

Reason for choice of neural net approach

It is difficult to design a filter using classical principles which can remove unwanted noise which does not smear the moving edges.

3.2 Feature Extraction

Application

New methods of coding videotelephone and videoconference images are being developed which attempt to generate models of the scene in order to extract the maximum amount of redundancy from the images. These methods necessitate the location of the objects in the scene as well as determining their shape and motion. One step along this path is to determine the position of the facial features. This is a difficult problem in machine vision since facial images do not generally contain hard edges which can be easily extracted. Although most faces have the same general structure there is considerable variation in the appearance and relative position of the features. The second test problem is to locate the eyes in an image containing a face.

In the event that Neural Nets prove to be satisfactory for this application extensions to surveillance and other scene understanding problems are envisaged.

Test Problem V2: Eye detection

The training and test data for this problem will consist of a set of still colour pictures each with a luminance resolution of 256 x 256 pixels. The faces will be approximately the same size in the images and will be front facing and vertical. The face may not necessarily be positioned in the centre of the frame. The eyes may be open or closed and the pupils may be looking straight ahead or to the side. The background will be unconstrained. The faces will be illuminated from the front by various forms of lighting.

3. VISION APPLICATIONS

3.1 Filtering for Low-bitrate Transmission

Application

The problem of removing noise from images before or after digitisation is an important one. After an image is digitised, data compression techniques are often applied which work by exploiting the statistical correlation between the pixels in the image. The efficiency of these techniques can be reduced significantly by the presence of noise in the source image. Conversely the data compression techniques can introduce noise. It is desirable, therefore, to add a pre- or post-filtering stage into an image coding system. Filtering can introduce undesirable degradations of the image such as blurring of edges. This effect can be reduced if the structure of the image is accounted for in the filter design. Image gradients which are due to the objects in the scene should be treated differently from those caused by random noise.

Test Problem V1: Filtering of noise from a moving sequence of edges

A neural net implementation of an image filter would have the advantage that it could learn or be trained to determine when such image gradients are due to noise or otherwise. The training and test data would consist of images with varying amounts of noise introduction. These images would be in the form of moving sequences so that inter frame (frame to frame) or intra frame (within frame) correlations can be exploited.

Test Data

The test problem data will be based on two existing moving sequences which are considered to be relatively noise free. These are the CCITT SG XV (specialist group on coding for visual telephony) standard test sequences CLAIR, first seventy frames and SWING, first three hundred and seventy five frames. Both sequences are in colour, with 24 bits per pixel. For the purposes of the test data only the luminance (Y) band will be used so the sequences will in effect be 8 bits per pixel monochrome images and in each case the picture resolution is 352 by 288 pixels. The CLAIR sequence is at ten frames per second and the SWING sequence at thirty frames per second.

Test Problem V3: Head and shoulders segmentation and feature detection

The third test problem is a more difficult version of the second. It will be required to segment the head and shoulders from the background and locate the eyes, nose and mouth. In the training and test data for this problem, the faces may be different sizes in the images and the head inclined at angles away from the vertical. Also the face may not be facing forwards but no full profiles will be used, so that all the features will always be visible. The head may not be positioned in the centre of the frame and the eyes and mouth may be open or closed. The background will be unconstrained. The illumination may be from the front or side using various forms of lighting.

Test Data

All images will be 256 x 256 pixels each image stored in a separate file. The images are colour and are in the Y,U,V component format. All Y (luminance) information is stored in one plane, followed by the chrominance components, U in another plane, followed by the V in a third plane. Each line of each plane is stored as a record which is packed array of 128 elements. Each element is a 16 bit word such that the first element contains the 8 bits of the first pixel on the line in the least significant 8 bits and 8 bits of the second pixel of the line in the most significant 8 bits. This pattern continues for alternate pixels along the line.

The test images are divided into three sets ordered in terms of difficulty for the test problems. Each set is divided evenly between the images intended for training and those intended for testing.

Set 1 - Preliminary simulations V2 and V3

These images are intended for preliminary testing of neural networks. All the subjects in each of these images are at the same viewing distance, their faces are approximately vertical, positioned in the centre of the frame and forward facing and their eyes are open and looking towards the camera. The set is divided into half male and half female, of various ages and skin colour. Some are wearing glasses and there are some males with beards and/or moustaches. The background is plain and the lighting is frontal but fairly diffuse.

Set 2 - Full testing V2, extended testing of V3

The same conditions apply as in set 1 except for the following. The faces may not be in the centre of the frame and the backgrounds are unconstrained. The eyes may be open or closed and the pupils looking forward or to the side. Various forms of lighting may have been used including flash and natural lighting.

Set 3 - Full testing of V3

The same conditions apply as in set 2 except for the following. The faces may be different sizes in the images and the head inclined at angles away from the vertical. Also the face may not be facing forwards but no full profiles will be used, so that all the features will always be visible. The illumination may be from the front or from the side.

Reason for choice of neural net

Rule based systems using template matching are unreliable, especially for tracking, or feature extraction under difficult lighting conditions.

4. SUMMARY OF SPEECH APPLICATIONS

4.1 Recognition of alphabet letters.

Application

There could be considerable use for systems using spelled input (eg Directory Enquiries). Such systems form a useful intermediate between normal keyboard input of text and full text to speech input.

Test problem S1

The test data consists of time wave-forms of one hundred speakers saying each letter three times, with a header giving the intended letter.

Reason for choice of neural net approach

The spoken alphabet is a particularly difficult set, including subsets which are very difficult to discriminate (for example B C D E G P V T Z- the 'E' set). Rule based systems often fail on the E-set in cases where speaker independence is required. It is hoped that speaker independent features can be learned.

4.2 Speech coding

Application

The removal of residual redundancy from prediction error in Linear Predictive coding (LPC) can further compress data obtained by the prediction process. It can therefore enable new or improved services to be introduced.

Some possibilities are a 4kbit/s speech channel, and improved quality at 8kbit/s and 16kbit/s (perhaps allowing satisfactory transmission of music)

Test Problem S2: LPC residual quantisation

There is some structure left after linear prediction and a neural net may discover the rules better than a human. The current intention is to use unsupervised learning - for example a Kohonen net (1). Hopefully the net will act as a vector quantiser by detecting clustering in some basis space for the input data. The outputs would then form a smaller set of data than the inputs and compression would have been achieved.

Data

Continuous speech LPC-coded residual.

Reason for choice of a neural net

It is difficult to express an intuitive picture of residual structure in the form of rules.

4.3 Yes/no recognition

Application

This would enhance speech recognition systems over real telephone lines. Perfect Yes/No discrimination can make a reasonable recognition system usable in the real world.

Speech recognition has numerous applications, for example, data base access or any other interactive information service.

Test Problem S4: Yes/no recognition using simple features

The neural net in this case would be applied to data which would already have been pre-processed by the extraction of certain features.

Data

The speech data for this problem has been collected over noisy telephone lines. This is real world information—with inevitable rogue data included.

Each word is split into five time segments, each segment has three features associated with it (eg prediction residual energy). This gives 15 features per word with 700 yeses and 700 noes. (Noes in one file, yeses in another)

Reason for choice of neural net approach

Rule based systems are confused by rogue data and attempt to model it. It is hoped that a suitable Neural Net could learn to reject rogue data.

Promising preliminary results have been obtained using a Multi-layer Perception (1) which models the whole set 100 percent correct.

5. Applications in other areas.

BT is also interested in other application areas for Neural Nets. It has a strong interest in natural language (text and speech), for a number of purposes-translation being one example, and natural language in man-machine interface for another.

Application for knowledge based systems are also of very great potential interest to BT. In particular a system for fault finding in telephone exchanges (where a rule based system would be hard to define) would be a powerful use for Neural Nets.

Certain problems in speech, not described in 4 above, are more related to information processing than the signal processing types of application described in 3 and 4, for example text to phoneme translation.

Test problems in these areas have been proposed, but they are not so immediately relevant to applications as those for speech and vision. It is hoped that collaboration with universities will result in some widely acceptable test problems being introduced for these areas.

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FACTORY AUTOMATION, ROBOTICS

FRG Funds CIM Project Development

36980174a Frankfurt/Main FRANKFURTER RUNDSCHAU in German 15 Mar 89 p 9

[Article by Josef Koenig: "'Factory of the Future'—In Bochum, Scientists Puzzle the Consequences: Pilot System Set Up on Campus of Ruhr University: New CIM Model Envisaged, Social Compatibility"]

[Text] The "factory of the future" is a provocative subject. People who talk about it generally picture a nightmare: deserted production halls, robots that have

take over almost every function and a few highly-skilled specialists who control and supervise operations by occasionally pushing a button.

Aside from the fact that a production facility along these lines will remain a utopia in technical terms, it is also unfeasible because of its inflexibility. This is something about which most experts can agree.

However, the possibility that a "factory of the future" can create and ensure new, skilled jobs has been the focus of work by more than 50 scientists at the Ruhr University in Bochum since the beginning of this year. Their interdisciplinary cooperation has been held up as a pioneering arrangement for the FRG: Engineers, sociologists, economists, labor experts, education specialists, psychologists and mathematicians have joined forces, their aim being to study and develop new computer-aided production networks, in terms of both technology and economic and social factors. Moreover, a pilot factory is being set up on the campus of the Ruhr University, where the project results can be tested in practice. For 3 years, scientists from various disciplines have been puzzling over a joint plan. Now it has been approved by the German Research Community (DFG), and an interdisciplinary special research project (SFB), unprecedented in its structure, has been established in Bochum. Its name: "New Information Technologies and Flexible Work Systems: Development and Evaluation of CIM Systems on the Basis of Partially Autonomous Flexible Manufacturing Structures." Between DM 12 and 14 million in funding is budgeted for the 3-year startup phase alone. The DFG, with a good DM seven million, bears the primary burden of financing. The remaining funds are being provided by the Land of North Rhine-Westfalia and the Ruhr University of Bochum.

CIM stands for "computer-integrated manufacturing." This means networking production structures with each other and with branches close to production, such as construction, planning, material storage and quality control. Elsewhere in the world, such systems in industry have been realized only as far as the initial phase. Although a large number of institutes are working on CIM solutions, most are based on the idea of a centrally controlled, flexible manufacturing system with a mechanized and automated material flow.

In contrast, Bochum's SFB is embarking on a new course. What is emerging here is a CIM structure based on networked, but also partially autonomous, and thus largely locally-controlled work units. In them, work stations are combined with a product orientation. At the same time, the system shifts tasks from central planning and control to the partially autonomous, flexible manufacturing structures, including tasks such as work preparation, planning, control, programming and monitoring. Moreover, in the interest of optimal flexibility, the new model does not incorporate a fully automated material flow.

The advantages of this decentralization are obvious: In terms of economics, companies develop a correspondingly high capability to adapt to ever more rapidly changing market conditions. At the same time, there is a drastic decrease in total job processing time, coupled with an increase in product variety and a drop in job sizes. A system that is decentralized in this way is particularly well-suited to the smaller series and single orders that will be in greater demand in the future. Because it can also be put into place in an enterprise gradually, it helps keep the investment risk low. The CIM system is thus tailored to the needs, situation and financial potential of small and medium-sized companies in particular. It is hoped that such companies will provide a strong impetus for structural change in the Ruhr area.

Social compatibility is very important to this plan. It is not oriented towards economic efficiency alone; rather, as a consequence of decentralization, it is also uncommonly supportive of employment. This point is emphasized by the SFB spokesman, political science professor Franz Lehner. To him, "thinned-out factories with only a few unskilled workers are out of the question." It is precisely in local, partially autonomous manufacturing that qualified jobs for skilled workers will be created and ensured. The project intends to counter the fears expressed in many debates concerning eliminating jobs and gradually disqualifying workers.

Thus, part of the project entails a group of labor experts and economics education specialists working on problems and strategies for improving the qualifications of employees in flexibilized manufacturing structures. And even today, the "CIM Technology Focus, Bochum," which is subsidized by the Federal Ministry of Research & Technology, offers one- or two-day survey, specialized and supplemental seminars to all interested parties.

The project is under the direction of Prof Wolfgang Massberg (chair for production systems and process control technology). He is also assistant spokesman for the SFB and deputy vice chancellor for the Ruhr University.

What is to be developed in Bochum over the coming years is not only an entirely new type of technical and organizational CIM model. With it there will also emerge integrated plans for work structuring, qualification, evaluation and adaptation into economic and social surroundings. And another special feature of this SFB: Additional progress control is being provided. To this end, labor economist Prof Erich Staudt is developing an evaluation system for the coordination, assessment and appraisal functions accompanying the SFB program.

Decline in FRG Industrial Robot Production Analyzed

36980175a Frankfurt/Main FRANKFURTER ALLGEMEINE in German 8 Apr 89 p 18

[Text] If the industrial robot were the standard for automation, German industry would be in a bad way. According to statistics published by the Association of

German Mechanical and Plant Engineering (VDMA) in Frankfurt, more than 100,000 robots are in use in Japan, while there are fewer than 20,000 in the FRG, where there is also a decline in growth. German production of robots has even decreased in absolute numbers: According to data from the VDMA in Hanover, only 2,240 robots were produced in 1988 (2,670 the year before); in the peak year, 1986, there were 3,420 units, as reported by the VDMA.

In a relative comparison, however, the association points out that many of the robots in use in Japan are very simple machines to which the VDMA definition (three free, independently programmable axes) would not apply; thus, a comparison of robot use cannot be used to establish that Japanese industry is in the lead. In addition, automation of production and of industrial assembly can also be achieved by alternative products and systems of assembly and manipulation technology.

According to association data, the entire assembly, manipulation and industrial robot technology sector increased its sales in 1988 by six percent, to DM 3.18 billion. A sales figure of DM 3.25 billion is expected for 1989. The employment figure for the 125 "critical" German companies in the sector increased in 1988 to 21,500 (21,000), and in this area the VDMA expects stagnation this year. The number of German companies will most likely decrease, since "certain concentration tendencies" can be observed, especially in the assembly sector. This reportedly has to do primarily with the growing capital needs for innovation and internationalization. Spending on research and development in this sector, at just under 10 percent of sales, is above average for mechanical engineering (three percent).

Despite the dropoff in robot production, the sector is in good shape, according to the association's data; one area to be addressed in transforming component manufacturers into "engineering-intensive system suppliers." This implies that industrial customers are attaching ever-greater importance to turnkey systems and facilities. The biggest hurdle in this structural change is the lack of technically qualified personnel, which is the same complaint voiced by nearly all branches of industry at the Hanover fair.

Status of FRG Factory Automation, Robotics

CIM Application

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 74-75, 78, 80

[Article by Reinhold Boehmer: "Automation: No CIM Without HIM"]

[Text] In manufacturing, the leading Western nations are to a certain extent strikingly different. West German companies mix well, without dominating. Still, the synonym for the computerized factory—CIM—is losing its lustre. Planners are rediscovering an old productive force, man.

The factories are as regal as the cars themselves. Be it a German Mercedes or a British Jaguar, both are manufactured under super-modern conditions—with a rating of "worldwide leader."

The highest praise, however, went to a Japanese industrial giant, Sanyo Electric Co. Ltd. No similar company in the Western world applies computers like they do at the production facilities of the electronics conglomerate in Osaka.

The industrial stars were selected by the management consulting firm A.T. Kearney GmbH and the Association of German Engineers (VDI), both headquartered in Duesseldorf. Now that the automation of factory facilities is scarcely under way, consultants, associations and institutes are already providing progress reports, in some cases meticulous ones. New, previously unpublished studies such as the one from Duesseldorf provide for the first time a comprehensive picture of the status of the factory of the future.

And this, according to Hans Herold, director of A.T. Kearney, "has surprises in store." For example, the first large-scale study, among 650 companies (annual sales of at least DM 50 million) in eight Western countries, in some cases reveals striking national differences. According to preliminary data, industrial enterprises in the FRG, the United States, Japan, France, Great Britain, Italy, Belgium and the Netherlands have automated their factories unequally.

"Industry in this country occupies a favorable but not dominant position in an international comparison," according to Herold's cautious assessment. The Germans have in fact most readily adopted automation in Europe, followed by the French and the British. In addition, all three countries have interconnected their systems equally well.

The neck-and-neck race applies to fully automated production, CIM (computer-integrated manufacturing), the synonym for the modern factory. The individual elements of CIM, with their confusing abbreviations, have been well-known and in operation for some time now:

- Computers are increasingly assisting in design (CAD);
- Computers are controlling machines, robots and systems (CAM);
- Programs are helping in production planning and control (PPS);
- Computers are improving logistical planning (CAP), taking care of the automatic recording of operating and machine data (BDE/MDE) and taking over quality control (CAQ).

For the CIM community, however, an optimally large number of systems is not evidence of modern production. For that, the future begins once information

between all the electronic work stations flows automatically and data no longer needs to be printed out, laboriously modified and re-input.

This high standard makes sense: In fact, it is now evident that only a planned short-circuit of the data flow—the integration of all computer islands—is economically forward-looking, bringing greater economy not only to the individual terminal, but also throughout many departments. This is indicated by a recently concluded study of more than 600 West German companies, conducted last year by the Institute for Machining Technology and Machine Tools (ITW) in Darmstadt for the Association of German Mechanical and Plant Engineering (VDMA).

According to this study, for example, companies that use design computers achieve 70 to 85 percent of their cost savings away from the electronic drawing boards, in the affiliated departments. In some companies with systems for production planning and control, only 10 percent of the profit comes from faster order processing; up to 90 percent of the savings—typical for CIM—is registered elsewhere, such as in the workshop or warehouse. In the past, however, the necessary networking of computer systems has been undertaken by industrial leaders in Europe and abroad only with hesitation. Computer integration fluctuates, measured according to what is theoretically possible, between 20 percent in Belgium and the Netherlands, around 25 percent in the FRG and just under 30 percent in Great Britain. "All things considered," says consultant Herold, warning against overinterpretation of the differences, "just a few, well-considered steps in the direction of CIM."

There are many reasons for this hesitation. Total expenditures in the millions for new hardware and software, for internal transmission networks and for specially trained personnel involve high risks. The Swedish automobile manufacturer Volvo had to discontinue its company-wide computer project, "Volvo Information System," after approximately 32 people struggled in vain with the computer equipment for 5 years—twice as long as planned.

Cost accountants are aghast, says Prof August-Wilhelm Scheer, director of the Institute for Economics Information Technology at the University of the Saarland in Saarbruecken, "at the unknown costing ratios in CIM factories." Very few dare to evaluate flexibility, better service and prompt delivery in marks and pfennigs; capital costs increase meteorically (WIRTSCHAFTSWOCHE 15/1988).

When electronics manufacturers build new production facilities over night, the radical changes become particularly clear. Thus, overhead costs at the IBM typewriter plant in Lexington, Kentucky fell from 42 to 18 percent of total expenditures, while direct wage costs dropped from 10 to 5 percent. At the same time, the share for materials exploded from 48 to 77 percent. At the works of Digital Equipment Corp. in Springfield, Massachusetts, direct labor costs even fell from 15 to less than 4 percent. "In this way, CIM factories are even competitive with companies in low-wage countries, such as Singapore or Korea," says economics information science specialist Scheer as encouragement to CIM skeptics.

Such encouragement is necessary, since the automators of factories are clearly not as bold as the manufacturers of modernization equipment would like. It is true that the companies, according to A.T. Kearney and VDI, plan to spend at least as much for CIM components over the next 5 years as they have in the same preceding period. Still, Erich Staudt, director of the Institute for Applied Innovation Research at the Ruhr University of Bochum, notes "depression" and "clear disillusionment" in the every-day production routine these days.

The concept of having all conceivable information concerning production centrally at hand is proving to be a "misconception," the professor thinks. A company "simply cannot be reflected as a whole through information." For example, the computers lack intuition or an outlook on what is needed right away.

The result is that in order for electronic production to take place despite the gaps in the computer's knowledge, the companies need increasingly better workers. In Japan, engineers are already working on machines that have been assembled into complex flexible manufacturing systems (FFS). "Many of our planners first go chasing after the overall CIM spirit," sneers innovation expert Staudt. "But once they have run up against a wall, they suddenly realize that they have to have more highly-qualified personnel."

The "current turnaround" (Staudt) in the CIM scene is being felt primarily by the personnel and organizational departments. "The vast majority of companies," Rolf Hackstein, director of the Research Institute for Economic Efficiency (FIR) in Aachen, has observed, "are simply not keeping up with training their people."

At the same time, CIM projects are faltering because production technicians are not changing the organization of labor—man in the role of a simple receiver of commands from an inadequate computer. Industrial sociologists at the Institute for Social Science Research (IFS) in Munich have summed up the experience of recent years in the slogan, "No CIM without HIM," meaning that without letting people act in harmony with each other, automation will not work.

The first CIM users are drawing conclusions from this "technical focus" (IFS researcher Christoph Koehler). Valentin Lambert, managing director of Zwick GmbH & Co. in Ulm, Swabia, now believes only in CHIM—computer- and human-integrated manufacturing. The "medium-sized West German company that has made the most progress in terms of automation," according to

the American "CIM Strategies" information service in its December 1988 issue, continually has 40 of its 400 employees engaged in internal training. And this is in spite of the fact that the introduction of CIM has just gotten under way.

The manufacturer of material testing machines plans to invest more than DM 16 million in computer-integrated manufacturing by 1995. "But there will never be a factory run by a computer," says Zwick chief Lambert. "The computers are there to simply supply the information, so that humans can work faster." It is only in this way that CIM can appeal to medium-sized businesses as well.

Other thoughtful modernizers are converting their factories by turning one large plant into many small ones under one roof. The idea of the "modular factory," made popular last year by Passau professor of business economics Horst Wildemann, is finding a ever-growing number of adherents. Thus, there will be no unified strategy for all companies—a consultant's maxim: "You don't buy CIM off the shelf"—even in the future. This is because automating the flow of data depends not only on existing hardware, software and machinery; it also varies according to the range of products offered and strategy:

- Companies that manufacture the same parts in mass production and want to outdo the competition primarily through low prices should focus automation on production data acquisition and quality assurance; coupling with the rarely needed design computer is of second priority.
- Manufacturers of high-variety products, who want to win customers primarily through tailor-made goods, should focus on having information flow like clockwork between the CAD system, the machines and the production planning and control computer.

According to information from the ITW in Darmstadt, German mechanical engineers are at any rate planning major moves in this direction. Based on manufacturer data, from three- to four-fifths of all drawings should be produced in 1992 on design computers—depending on company size—which is four to nine times as much as in 1987. Operative programs will also come from the computer more frequently, around two to three times more than a year ago. For Lothar Wolf, senior European industry analyst for the market research company Dataquest GmbH in Munich, the current disillusionment with CIM accordingly will not result in a breakthrough in demand for automation equipment. "The company budget will no longer be invested in total automation, but rather will be prioritized for coupling design and production, thus CAD/CAM," says the CIM specialist. Factory planners here have in the meantime learned "that not everything in production can be done by computer," he says.

The Incalculable in Figures: Projected financial profit from computer-integrated manufacturing, based on the example of a medium-sized company (around 400 employees, DM 75 million in annual sales, DM 16 to 18 million in CIM investment)*

Improvements	Expected Benefits	Projected Financial Gain (from 1988 to 1991)
Time needed per order	33 percent reduction	DM 20 million more sales
Capital costs	33 percent reduction	DM 6 million savings
Meeting of deadline	50 percent improvement	DM 3 million more sales
Customer service	25 percent improvement	DM 3 million more sales
Company image	30 percent improvement	DM 7 million more sales
Personnel costs	5 percent reduction	DM 2.5 million savings

*Computer and Human Integrated Manufacturing (CHIM) Project at Zwick GmbH & Co., in Ulm; Source: CIM Strategies

Assembly

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 80, 82-83

[Article by Dieter Duerand: "Assembly: Sensitive Grip": first paragraph is introduction]

[Text] There are still many more options for improving economic efficiency in screwing, inserting and joining. Less than five percent of the processes are automated. There are now plans for robots with adroit grippers and sensors to take over work that has long been considered the domain of the human hand.

Scant opportunity for iron pinchers: Lines and cables bend, and rubber and film curl up if insensitive grippers undertake the task. For a long time, contact with soft and limp materials appeared to be the exclusive domain of the fine sense of touch of the human hand.

For 6 months last year, researchers from Munich's Institute for Assembly Automation GmbH tested the opposite view at an assembly line in the Sindelfingen plant of Daimler-Benz AG. A robot feels for elastic mats with suction cups, tugs them through the open front windshield into the interior of the car and lays them on the front floorboards, accurate to the millimeter. Small black-and-white cameras observe the process; after 90 seconds, the computer-aided helper has finished its task.

Soon, the Stuttgart auto manufacturer wants to use automation exclusively to install insulation in its vehicles, including under the roof. In this way, engineers are getting their hands on more and more parts whose assembly was previously thought to be out of the reach of automation. Lately, robots have been putting limp seals in window frames, applying thin films to car doors without wrinkles, moving and rewinding entire bundles of cable, clipping and clamping, and assembling automobile dashboards or entire wristwatches. "We are handling pliable parts better and better," says Manfred Schweizer, director of the Fraunhofer Institute for Production Technology and Automation (IPA) in Stuttgart. At the Hanover industry fair, the Wuerttembergers presented for the first time a machine that can install the hose connecting the engine and radiator. And this even though the bends in the winding part cannot be calculated. The new assemblers owe their improved skill to the ever more refined sensors with which the researchers have taught them to see, hear and feel.

However, automation experts continue to have a hard time with some assembly tasks. Thus, an experiment at the Saarlouis plant of Ford-Werke AG whereby robots were to screw the wheels onto a car failed. The speed of the assembly line overtaxed the clumsy machines, and now deft human hands are again securing the wheels.

But the engineers' urge to invent continues. At the Fraunhofer Institute for Production Systems and Design Technology in Berlin, robots are even learning to work hand in hand. One of them holds a pipe, for example, to which the other applies a clean weld. The points that are worked on are always on the horizontal. For humans, this—coordinating both hands—is child's play. For robots to do it, extremely complex calculations must first be prepared and new, extensive computer programs must be developed.

Despite the rapid speed of technical progress, less than five percent of all assembly processes in this country today are automated, according to estimates by IPA expert Schweizer. Of the 17,700 industrial robots at the end of 1988, less than one-fifth were inserting, screwing or joining something, the majority of them still in automotive manufacture. Nevertheless, the number of assembly robots has for several years been growing more rapidly than those involved in welding, forging, painting or coating.

One significant reason for the continued hesitation is uncertainty concerning the economic feasibility of automation equipment. Admittedly, the horizontally movable Scara robots, specially developed for assembly, have continually become more efficient and more inexpensive. At present, one machine costs only DM 40,000, including computer control and the programming unit. Still, the necessary trappings, the so-called peripherals, quickly take the price into the hundreds of thousands. Among the expensive accessories are sensors, grippers or tools.

It is a rule of thumb that investment should not exceed DM 80,000 per job if it is to be recouped in the short term, such as through the elimination of labor costs within one year. Those concerned with saving resources also shy away from the high acquisition costs because it is often difficult—if at all possible—to convert the machines for new products and models.

Designers are drawing conclusions from all this. Quick tool-changing systems and several working programs stored in the control memory are making robots more versatile. Machines are being developed that work on call. And engineers are increasingly replacing expensive sensors with more inexpensive mechanics—with astounding success.

For example, a robot with a mobile gripper developed by IPA in Stuttgart finds the hole for a screw, even after initially poking around a few millimeters away. Engineers also thought at one time that a contact on a flexible wire could be inserted into a casing only using expensive sensors. However, it can also be done cheaper and faster—with cautious vibrational movements.

The bill: The simple system without a robot costs only DM 3,000. Sensitive sensors take the system price up to DM 10,000, and with a camera it can even go as high as around DM 100,000. "And the mechanics are more reliable," emphasizes IPA's Schweizer.

If there is any future role for robots in assembly, the engineer believes that it can be played only by versatile and easier-to-use robots. Accordingly, special machines in the year 2000 will have a place only where several identical steps must be undertaken, such as in the assembly of video cassettes.

Clearly there are means of improving economic efficiency other than automation, such as assembly-oriented product design. According to a study by the Institute for Industrial Production and Factory Operation of the University of Stuttgart, this could lower assembly time in automobile manufacture by 11.5 percent, and in the clock industry by as much as 21.5 percent. Other significant potential for savings can be found in the use of new materials and in simplified work flow.

The degree to which the consistent application of all options for optimizing economic efficiency can accelerate the flow of production and lower costs was noted by industrial engineers at the Wetzlar GmbH machine factory, a subsidiary of Philips, last summer during the development of a new production line for car radios with cassette recorders.

It used to take several days to assemble one unit, but today it takes only 2 hours. The company can thus respond to new orders much faster. In order to switch over to production of a different model, the workers need exactly 10 minutes, instead of several hours. Several jobs were also eliminated.

While at Wetzlar a large number of the jobs were retained even after extensive automation, there are examples of nearly deserted assembly halls in Japan, where 10 times as many robots are in operation as in this country. At Oki Electric Industry's Tohoku plant, 48 robots and 22 screwing machines assemble three different printers in 18-second cycles—around 2,000 units a day.

The 12 workers who are left are needed only for conversion work—and in case one of the machines breaks down. Until the repairs are complete, the other workers continue assembly by hand, thus keeping production going.

Sensors

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 p 83

[Article by Dieter Duerand: "Sensors: Scanning and Touching"]

[Text] They are agile and quick, the new robots. One of them juggles a pen back and forth between its three fingers. Another plays table tennis, hitting the ping-pong ball at exactly the right speed. The necessary data on the course of the small white ball are provided by several cameras.

Using highly sensitive sensors, engineers are making better progress at technologically imitating important human capabilities such as seeing and touching, and at teaching them to machines. Thanks to the latest video camera systems, they can now not only distinguish between black and white, but also recognize gray tones and see three-dimensionally. In this way, for example, it can grab a specific object from a box full of objects arranged in no order; or, the mechanical helpers can move about in a work area filled with many objects without colliding.

But even more important is that the machines are increasingly able to independently correct inaccuracies—either in the workpieces or in their own movement sequences. An example of this is the difficult mounting of electronic components on printed circuit boards. At the Fraunhofer Institute for Production Technology and Automation (IPA) in Stuttgart, for example, an image processing system measures the position of the thin connecting wires. A microprocessor calculates how the robot hand should plug in the crooked legs, one after another. Another new optical development is the laser scanner. Using a number of beams, it simultaneously scans several important assembly control points and in this way supersedes several expensive, individual sensors.

Lately, springs, sensor pins, wire strain gauges and sensor hairs have given a new magnitude of sensitivity to robot gripping tools. Pressure sensors notice whether a target object is wrongly positioned, and report the corrected data to the electronic brain. They sense contours and recognize which object concerns them and with what amount of force they must approach it. Special moment of force sensors record all resistances occurring during assembly and independently alter their own courses of movement, by way of so-called active tolerance compensation systems.

Despite the high level of technical progress, however, the trend is moving away from more expensive sensors. "The darn things are trouble-prone and break down easily," Manfred Schweizer, director of the Stuttgart IPA, says disparagingly. In addition, there are high acquisition costs; an electronic image processing system can cost up to DM 200,000.

Which makes an idea by engineers at the Laboratory for Machine Tools and Industrial Studies in Aachen all the more appropriate. One of their robots alternates optics with each gripper. The advantage: The camera always records the right image segment, so that it is no longer necessary to use several cameras.

Precision Machining

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 86, 88

[Article by Reinhold Boehmer: "Precision: The New Sensitivity"; first paragraph is introduction]

[Text] With millions from Bonn, West German mechanical engineers want to soon be building high-precision parts and smooth surfaces to rival the foreign competition. The problem: ultra-precise machines are themselves ultra-precise products.

A small nudge with the index finger is enough. Silently, the anthracite-colored granite block, weighing a good 250 kg, glides across its base. There is no friction, no squeaking. A cushion of air lifts the quarter-ton piece of rock exactly one-hundredth of a millimeter in the air—enough to make the block a super-maneuverable, and yet imperturbable transporter.

Using these and other extreme processes, scientists at the Fraunhofer Institute for Production Technology (IPT) in Aachen are attempting to effect a breakthrough in a highly sensitive technology: ultra-precision machining. Using tools mounted with ultra-finely ground diamond crystals, it should be possible to perform large-scale cutting and turning with an unprecedented—at least for West German mechanical engineers—degree of precision. The result is a product whose shape deviates from the ideal by no more than one ten-thousandth of a millimeter, and whose smooth surface features similarly slight relief variations. Manfred Weck, director of the Production Machines Division at IPT, at any rate

believes in the "increasing demand for highly-precise machining tools." These already include:

- Optical memory, the basic material used for chip production (wafers), compact discs (CD) or fixed disks in computers;
- Equipment for increasingly important optoelectronics—from the metal reflectors in laser copiers, to randomly shaped (aspherical) concentrating reflectors, to ultra-translucent lenses;
- Precision-mechanics products such as injection nozzles and valves, but also compression molds for plastic parts with especially smooth surfaces.

Practically speaking, engineers in this country must pass when customers in industry want ultra-precise systems. Users have only two options. One is to go abroad; thus, 2 years ago, Rodenstock GmbH in Munich bought a system by the U.S. manufacturer Rank Pneumo Inc. to produce ultra-high-quality optics. Or, companies can produce their own equipment. The leaders on the international market, according to Prof Week, are Japanese, American and British machine tool manufacturers.

In order to make up for this lag, some companies came together back in 1986 to form a joint ultra-precision technology research group. This association currently has 26 members, including chemicals giant BASF, electronics conglomerate Bosch, precision mechanics producer Diehl, a subsidiary of ball-bearing manufacturer SKF, optics specialists Zeiss and Leitz, and machine builders Boley, Gildemeister and Heidenhain. And even the Federal Ministry for Research & Technology is involved—with a projected DM 10 million in taxpayers' money for a "joint project" to "develop application-oriented ultra-precision technology with geometrically specified cutting edges."

This is definitely not a simple matter, since machines for turning out ultra-precise products are themselves ultra-precise products. The carriage that moves the workpiece towards the cutter cannot quiver or deviate from its track; the spindles on which the cutting tool is positioned cannot be deflected by friction during rotation. The solution: a bearing of compressed air or oil. For surface measurement, the standard fine needle, the perthometer, drawn once across the part, is no longer adequate. Laser instruments must be integrated into the system, in order to determine the roughness of the workpiece without contact and without leaving tracks. In addition, the filigree systems demonstrate their pedantic precision only at a constant room climate—temperature, air pressure, humidity.

Once the processes have been developed, the prospects of success are not bad, as tests on a highly refined cutter at G. Boley GmbH & Co. in Esslingen have shown: Spindles with air bearings turned on their own axes with double the precision of those with ball bearings. They left tracks only 3.6 millionth of a millimeter high or deep on the workpiece surface, and worked 10 times as fast.

There are only vague estimates of how many of these machines can be sold. "We are fully optimistic, within limits," says Wolfgang Pfeifer, head of development at Boley. On the one hand, the ultras are counting on an increase in demand for high-tech products. On the other hand, they are counting on using the super systems to save on later surface treatment using environmentally harmful pastes—lapping, in the jargon—as well as fine-rubbing with correspondingly shaped stones, or honing.

There are further incentives for customers to buy at least precision cutters. Currently, says Rolf Eckstein, assistant managing director at the Wendt GmbH diamond tool and machine factory in Meerbusch, near Duesseldorf, precision is still determined by "the feeling and experience of the machine operator." If both are no longer required, then there are further disadvantages for the company, the engineer says: "High machine costs per workpiece as well as high labor costs for qualified machining personnel."

High-Speed Metal Cutting

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 88, 97, 99

[Article by Reinhold Boehmer: "Manufacturing: Voracious Cutter"; first paragraph is introduction]

[Text] In traditional materials processing—in metal-cutting—high-speed fever has broken loose. New types of high-speed machines are working unmachined parts into appropriate shapes much faster and more gently. Aircraft and automobile manufacturers are already using the high-speed rasps.

Sparks fly. Smoke billows up, and a spray of bright iron shavings lands on the floor. It smells like overheated metal. Twenty cutters, implanted in a rapidly rotating roller, have just made two passes over a cast-iron engine block at 25 kilometers an hour, creating a deafening noise. Once more, the super-hard blades dig in. Then, after a ridiculous 15 seconds, the edges of the cylinder head are 13 millimeters shorter, and they are level.

On 16 May, the DM 1.8 million facility at the W plant of Ford-Werke AG in Cologne is due to start up operations. Every day, around 5,000 engine blocks, intended for Ford mini-van production in the United States, will then come under the knife, the cutting speed of which is nearly three times as much as with standard iron rasps.

Special machines such as these signal a high-tech shift in a highly traditional area: anywhere that unprocessed material is transformed into polished material through the removal of shavings.

In principle, parts take shape here in two ways. They are either milled, meaning that a cutting tool rasps—if it is rotating about its own axis—over a stationary workpiece and thus makes it into the desired shape. Or, the part to be finished is rotated; in this case, the unplaned piece itself rotates, and a sharp chisel digs into the moving body.

The basic laws of the old technology have been known since 1931. The faster the elaborately shaped blades cut into the material, the hotter they become—until at a certain cutting speed they melt or in some other way are rendered useless. At an even higher speed, the effect again subsides; if the temperature falls far enough, the parts can actually be produced much faster than before.

The speed to be exceeded varies, depending on the material, from a good 300 meters a minute (around 18 kilometers an hour) with nonferrous metals such as red casting or regular brass, to fantastic figures such as 39,000 meters a minute (2,340 kilometers an hour) for cast iron and 45,000 meters a minute (2,700 kilometers an hour) for steel.

It is only in the 1980s that machine manufacturers have begun to take another good look at high speeds. In the past, the focus has been on automating the time-consuming process of changing the cutting tools. In addition, they have replaced hand-adjustment of the cutting and lathe banks with programmable controls. In the meantime, however, the potential for further optimization of economic efficiency has been exhausted to such an extent that apparently only faster cutters can save more time.

They are now facing the "big breakthrough," believes Herbert Schulz, head of the Institute for Machining Technology and Machine Tools of the Technical College (TH) of Darmstadt. With high-speed cutting (HSC) in particular, the first manufacturers have begun mass production based on newly-designed super facilities. For example, Munich's Friedrich Deckel AG, which demonstrated an HSC prototype at the Duesseldorf METAV mechanical engineering fair last year, plans to offer the first ready-made high-speed cutter at the EMO European machine tool exhibition in Hanover this September.

Companies have been helped along in making the jump by the Federal Ministry for Research & Technology (BMFT). From 1984 to 1988, Bonn allocated around DM 11.6 million for developments in machining technology. The beneficiaries include—directly or indirectly—Siemens, Daimler-Benz subsidiary MTU, Bosch, Volkswagen, MBB [Messerschmitt-Boelkow-Blohm], the renowned Heidelberger Druckmaschinen AG, and the medium-sized Deckel.

The advantages that have emerged have put HSC initiates in an optimistic mood. Thus, studies at the TH Darmstadt have shown that HSC systems can remove three to five times as much material in the same amount of time as standard machines. Aircraft manufacturers in particular are betting on the voracious milling cutters, since in order to produce wing sections or cabin shells they have to remove up to 95 percent of the material from enormous metal blocks.

The fast rasps also exert up to 30 percent less pressure on the unfinished parts. This means less wear on the tool; the cutter does not have to be reground as often, it functions with greater precision and it lasts longer. The workpieces stand up to the rapidly but gently rotating blades without having to be first clamped in chucking fixtures, which is expensive and time-consuming. And the fast tools oscillate at a natural frequency that is so high that even thin-walled parts no longer adopt their fine quivering—a broad field for undreamed-of applications.

Even heat-sensitive materials, such as synthetics, especially those reinforced with carbon fibers, are now accessible to traditional processing techniques.

The leading user and HSC promotor in this country is Messerschmitt-Boelkow-Blohm GmbH (MBB), which produces parts for the multipurpose combat aircraft Tornado and the European Airbus. With an HSC system, MBB has been able to machine 14 different airplane parts 36 percent faster on the average by tripling the number of tool revolutions per minute to 12,000; at 24,000 rotations, the reduction was as much as 66 percent. At the same time, it has been possible to produce significantly thinner webs, which help stabilize parts of the airplane. The savings in overall weight: up to 15 percent.

The automobile industry is also discovering the rotating super-whizzer. Products as complicated as the turbocharger, which pumps exhaust into the engine and helps the car achieve undreamed-up power, can apparently be produced profitably only with HSC machines. VW, for example, has a 115-horsepower Polo G 40 in its production plan only because the Wolfsburg plant has a corresponding pilot system at its disposal.

Because of its lower power, the machine easily cuts spiral furrows 13 millimeters wide and no more than 60 millimeters deep in a blank made of light metal. This must be followed by grooves for packing rings in the raised, scarcely 3-millimeter-wide web that are 1.5 millimeters wide and 3 millimeters deep—without the thin walls giving way.

Such highlights have yet to elicit high spirits among the manufacturers. Manfred Werkmann, a market researcher for Deckel, does expect an increase, but "no booms" in the cutter business because of HSC. Super systems such as those demanded by aircraft manufacturers are needed in minute "homeopathic quantities," he says.

Georg Werntze, the Maho AG (Pfronten/Allgaeu) board member responsible for production and technology, even believes that specifically high-speed machining is bound to conditions "that make general use unfeasible."

There is something to be said for this viewpoint. For example, cutters that feed to the workpiece at 60,000 to 100,000 revolutions and a speed of upwards of 30 meters a minute are precise only if the controls react faster than scarcely any machine on the market is capable of. For example, the market leader, Asciera AG, in Le Locle, Neuchatel, Switzerland, must take its controls up to turbo speed with extra computer hardware. The user assessment: "Ridiculously expensive."

Also needed are more efficient engines and spindles, new tools and expensive protective measures to safeguard the worker from bullet-like tool splinters. An increase in costs of up to 30 percent is not inconceivable.

Whether customers are willing to swallow these added costs depends not entirely on the increase in productivity. HSC advocates figure that the higher expenditures will lead to products that do not yet exist. An example: VW's turbocharger. "Essentially, HSC is a technology for producing new things," says cutter expert Schulz.

Meteoric Growth: Projected World Market for High-Speed Cutting Machines (in units)

Machines	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Small systems[1] (unit price: approx. DM 300,000)	800	1000	1200	1500	1600	1700	1800	1850	1900	2000
Medium-sized systems[2] (unit price: approx. DM 700,000)	30	80	150	200	250	300	350	400	450	500
Large systems[3]	Up to 20 a year									

[1]For parts under 0.250 cubic meters; [2]0.250 to 0.800 cubic meters; [3]Made to customer specifications, greater than 0.800 cubic meters; Source: Deckel

Quality Control

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 99, 102

[Article by Christian Sachse: "Quality: Automated Check"; first paragraph is introduction]

[Text] Using computers and statistical methods, companies are attempting to automatically control assembly and production, as well as chemical processes. The goal: the longer production takes, the higher the quality of the products. Admittedly, however, the self-controlling machines are not cheap.

It sounds like a truism. "We initiate something before something happens," says Rainer Koch, the man responsible for statistical control at the Ford-Werke AG transmission plant in Cologne. But the challenge is caught up in details. The goal of the auto manufacturers for the future is that only three instead of the previous seven out of 1,000 parts emerge from the machines with defects. The desire by companies like the U.S. conglomerate to improve production has to do not only with fiercer competition. The flip side of the quality coin is cost. Today, between four and eight percent of sales, or 6 to 12 percent of production costs, goes to maintaining and ensuring product quality, according to estimates by the Italian automotive giant, Fiat. New statistical methods, as well as modern process measuring and control technology should be of help here.

At its transmission plant, for example, Ford is currently producing five parts, including brake disks and forks for cardan shafts, using so-called automated measured value controls. Each machine contains a device that measures the finished parts and transmits the values to a computer that compares them with the given tolerances. If there are deviations, the system automatically makes adjustments.

Lately, Ford has also been prescribing a corresponding system for its suppliers. In "Instructions Q101," a thick book that sets exact criteria, the quality standards and verification methods are defined. Expensive entry controls by Ford are not necessary—the manufacturers' test records are adequate.

Now, only companies that comply with these conditions have any chance of doing business with the company. This has far-reaching consequences. Between 100 and 200 suppliers were bumped off after introduction of Q101. Koch's maxim: "We deal with not the cheapest supplier, but the one with the best quality."

The big and the smart have understood this. Bosch, universal joint manufacturer Walterscheidt in Lohmar or Fichtel & Sachs are fully automating quality assurance on their assembly lines and in the same way eliminating inaccuracy in their finishing machines.

However, installing self-controlling systems entails problems, especially in automobile manufacture and machine building. While a single value, such as temperature, is generally adequate for controlling processes in the chemicals industry, there are often several parameters in machining unfinished parts.

For example, technicians at Volkswagen AG in Wolfsburg are complaining about quality control in body construction. For the external shell of the car, it is not enough to define an average value; with products that

undergo several working steps and come into contact with a large number of tools and plant facilities, the source of each defect must be isolated and localized.

A great deal of technology affects economic efficiency. There are 60 to 70 measurement points on the body of the VW Jetta alone. Each one requires average investments of DM 10,000 to 50,000.

In some areas, however, VW has introduced automatic checks, such as in screwing. There, the machine measures the torque, travel and angle of twist and stores the results in a computer. If the values exceed the set limits, the screwdriver is automatically adjusted. Each screw is snugly in place without having to be tightened by hand by a worker. Lothar Mueller, head of the assembly maintenance department in the highly automated Hall 54 at VW: "If this process were not self-checking, it would mean significant additional expenditures for quality assurance measures."

Scientists have already converted their practical experience into a handy formula. "Quality assurance in manufacturing and assembly is based on quality control systems close to the production process," says Juergen Blaesing, lecturer in quality technology at the Ulm Trade School and head of the local Transfer Center for Quality Assurance.

Most of these control systems are based on statistical process control (SPC). In this process, several measurements are combined into one random sample, which yields an average value. This, instead of individual measurements, is related to an established best-value. At threshold values—so-called intervention limits—the systems automatically self-adjust before tolerances are reached or exceeded.

Bernd Stenzel, head of marketing for the Reorg-Gesellschaft for Computer Applications, Organization and Measurement Technology mbH in Juechen, near Cologne, sees applications for SPC primarily in mass production: in turning, cutting and drilling, in monitoring torque and in chemical processes. In his opinion, the major advantage of the control process is that the intervention limits for the machines can be drawn closer and closer together as control over production improves. "In this way," says Stenzel, "the quality of the products is continually better and more consistent." Thus far, few companies have used these systems. According to estimates by Norbert Stoeck, head of the automation department at Munich's Roland Berger business consulting firm, the market for SPC software in the FRG is currently DM 30 to 40 million a year—with an annual growth rate of around 30 percent. Bright prospects for companies such as Komeg in Riegelsberg, Rheinmetall Mess- und Prueftechnik, Dornier-System, Hewlett-Packard, Tema, Marposs or Moesers, the primary suppliers in this country.

However, experts believe that it will be some time before SPC makes a major breakthrough. "This is new terrain for us," admits VW quality-control man Nimz. In order to stay on solid ground, new users must first of all acquaint their staffs with the new technology. Ford's Koch scarcely has any time away from the classroom. His current course load: two to four classes a week.

Maintenance

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 p 102

[Article by Christian Sachse: "Maintenance: Help From the Computer"]

[Text] Wilfried Sihn, project leader for maintenance at the Fraunhofer Institute for Production Technology and Automation (IPA) in Stuttgart, is amazed at the naivety of many companies: For many of them, systematic maintenance for their machine outfits is merely an abstract concept. For experts like Sihn, it is questionable whether anyone will still be able to afford such neglect in the future. Even today, automobile manufacturers are demanding from their suppliers detailed information on systems upkeep and documentation on downtime. With just-in-time programs—meaning production on call—no automobile manufacturer can afford defective parts and a backlog situation.

For this reason, more and more personal computers (PCs) are finding their way into factory halls. They record the operating data from the machines and provide for them a reporting system that drastically lowers the amount of maintenance in the manufacturing industry due to defects.

Leading companies in this field are machine tool manufacturers such as Traub, Trumpf, Maho and Deckel. The intelligent machines can localize up to 500 sources of defects and display them on the screen. Directions for eliminating the defect are then immediately provided on the monitor.

Still, this process should not really be necessary. Sihn sees a trend whereby the PC in the future will be used primarily for diagnostic purposes. To this end, the machines will be continually checked by the computer. An intelligent, adaptive program, a so-called expert system, evaluates the collected operating data, assesses the status of the system and promptly recommends maintenance and servicing measures before a defect can even appear.

Messerschmitt-Boelkow-Blohm is just now in the process of installing this type of system for manufacturing aircraft. Ultimately, the computer should request and analyze 10 units of information from the machines and list the causes of damage.

However, diagnoses of production equipment require refined sensor systems that must be planned during construction of the machines. Because many economic efficiency reserves in manufacturing are exhausted, IPA's Sihn believes strongly that mechanical engineers are aware of this challenge.

Materials Handling

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 105, 107, 110

[Article by Martin Muras: "Logistics: Mobile Materialists"; first paragraph is introduction]

[Text] Only 12 percent of all West German companies send unfinished or semifinished goods through production according to logical programs. This number could be higher. Now there are new types of mobile robots and driverless transport systems that allow material to flow even faster.

As if controlled by an invisible hand, the driverless vehicle rolls from the stockroom into the factory hall. At a machine tool, it stops and turns. A robot mounted on the carriage begins to move. It grabs a workpiece from a table also on the carriage, and sets it in the machine.

Hermes, as the iron transport worker is called, is a so-called mobile material-handling robot. It receives its commands from a computer, its eyes from an infrared camera.

Fully automated, computer-controlled vehicles with a robot are the latest thing in the area of transport technology. The novelty now is that the team gets material from the stockpile and also helps machines during production. This speeds up manufacturing and makes the flow of material more flexible for different applications.

"These vehicles are pioneering developments for the factory of the future," says Reinhard Juennemann, head of the Fraunhofer Institute for Transport Technology and Goods Distribution (ITW) in Dortmund, whose engineers developed Hermes.

Companies are interested in new transport technologies now more than ever, because unfinished and semifinished goods continue to pass through the factories at a slow pace. In the machine engineering industry, for example, only 10 percent of the time that it takes to finish a product is actually spent on machining. The rest of the time is spent waiting ahead of or behind the machines. "Inventory costs are generally too high. One-third of total sales is spent on maintaining stockpiles," says Guenther Pawellek, logistics specialist at the Technical University of Hamburg. And so one thing is clear to ITW head Juennemann: "We must reanalyze the processes throughout the entire company in order to better control, monitor and plan the flows of materials and information." Ultimately—as envisioned by the logisticians—goods will go from the supplier, across the loading ramp and through the end producer's manufacturing process without having to be pushed, lifted or driven around by humans.

The ITW engineers believe that this type of chained effect can be realized with special computer programs and driverless transport systems (FTS); with mobile robots, telpher lines or cranes.

Currently, these programmable systems are being used primarily for just-in-time production, which is where parts are machined at the exact moment that they are needed for assembly. For many different types of products, this requires strict organization. The automobile industry has been successfully applying corresponding cost-cutting logistical methods for years now.

Lately, companies in the chemicals industry such as Avon and Ciba-Geigy and electronics conglomerates such as Siemens and AEG have been attempting to get control over the flow of parts and materials using the new equipment. But a study by the Federal Association for Logistics in Bremen showed that 88 percent of all West German companies still lack a unified plan for logistics. Some of them first test a so-called insular solution, meaning that they automate only one operation—such as the stockpile.

"But even insular solutions have a positive effect," Werner Scholz, the technical head of Bartling-Werke GmbH & Co. KG in Selm-Bork, Westphalia, is convinced. The company, which produces and markets disposable tableware, has invested more than DM seven million in a computer-monitored high-shelving warehouse.

Two automatically controlled service units move on tracks between the movable shelves. Using elevators—so-called conveyors—the units come to individual compartments, where they insert or remove pallets. Where there used to be a "chaotic situation" (Scholz), there are now 14,000 pallets managed systematically. Still missing is the connection between the transport unit and productions. "If the technology proves its worth," says Bartling's Scholz, "we'll be making that investment too."

The fact that only 12 percent of all companies have introduced a complex logistics program can be attributed to the investment that is required, often running into the tens of millions. It is unclear whether operations will then run smoothly. The computer programs present even more problems, and difficulties with the software negate the benefits of otherwise ingenious transport systems. "We have many people who are interested, but practically no buyers," Matthias Daum, head of the transport, reloading and stockpiling technology department at ITW, says soberly. "And that despite the fact that the machines are fully operative."

Nevertheless, a rosy future is envisaged especially by designers and manufacturers of driverless transport systems in conjunction with consignment robots, which take various parts from the stockpile and combine them into packages for assembly. Thus, the ITW creation "Romeo," using suction cups, can pull various packaged articles from different shelves and deliver the necessary amount, ready for shipment. One potential field of application: the wholesale grocery trade.

For smaller components involving soldering and wiring by electronics manufacturers, however, a mobile consignment system (MKS) is more appropriate. This system removes the containers of transistors, capacitors and circuits from the shelves, puts them on a table and transports them to a conveyor belt that leads into the production area.

Siemens AG wants to use 13 of these devices in its new laser printer plant in Munich. "MKS doubles the pace of material flow," Rolf Stockert, head of the material flow planning department, says happily.

Driverless transport systems work not only on the ground. Above the machines, cranes or telpher lines connect several areas of operation. They can transport workpieces or tools and service machines—depending entirely on the demands of production.

In order to integrate all this equipment into operations, advanced users are developing their own computer programs. At Volkswagen, the transporters respond to a software program called Febes, while Duplex-Sicomp instructs the machines at Audi. Despite the differences in the programs, it always takes about the same amount of time to solve the problems that arise after installation. "It takes months for a system like this to run free of bugs," says Winfried Misselhorn, head of conveyor planning at VW in Wolfsburg.

And the economic savings can be even greater. "But it is only possible if the suppliers are involved in the logistics plan," says VW board member Horst Muenzer. This is why his company, like other auto manufacturers, is in continual contact with the most important of its parts producers, in part through telecommunication links.

At its new laser printer plant, Siemens has even ingeniously organized production in such a way that 10 percent of the outside parts, which constitute 80 percent of the product value, are delivered directly to production. "We no longer have to store this expensive material. Our immobilized capital has been reduced enormously," according to logistics chief Rolf Stockert.

In this way, 1,000 small parts are fed into assembly using mobile consignment systems and conveyor belts, all synchronized with production. Larger items, such as printer cases, are brought in according to need on driverless transport systems. VW, Audi and Siemens demonstrate that the software problems are not insurmountable. This is not enough for the engineers, however. The future belongs to standardized information and transport systems, operating in as many companies as possible. "Today, we must still formulate an individual logistics program for each company," ITW's Daum says critically, "and that drives the cost sky-high."

Computer Simulation

36980179 Duesseldorf WIRTSCHAFTSWOCHE in German 24 Mar 89 pp 110-112

[Article by Andreas Molitor and Reinhold Boehmer: "Simulation: Test Run on the Terminal"; first paragraph is introduction]

[Text] Factory planners are no longer satisfied with discovering errors once production is already under way. Lately, computers have gained the ability to simulate entire plants that have not yet been built. One thing, however, will never be replaced by electronics: the creativity of the planner.

The task was tricky: For their Omega model, the engineers of Adam Opel AG had to redesign a complete automotive plant, from top to bottom. Throughout months of meticulous work, they calculated in detail what capacities they would need to produce wheels and machines at the same pace, always with utilization close to capacity. However, the strategists at the General Motors (GM) subsidiary did not want to wait until later on, during actual operation, to learn whether they had made any errors. Thus, all the planning data were fed into a computer—as well as downtime and nonproductive time according to the schedule for the machines at the GM plants in Zaragoza, Spain and Bochum.

Taking into account work and material flow, the computer carried out the production process as if the factory were already standing. The result surprised the people at Opel: The original plans were anything but optimal, and investments could be reduced by DM five to six million. Since then, the slogan in Ruesselsheim has been "simulation before investment."

Using powerful computers (hardware) and programs (software), production planners are increasingly testing their ideas first on the monitor, instead of in reality.

Individual production steps and logistical processes are simulated in the computer as a simplified model. The electronic system then begins the fictional assembly or supplying of materials. The developer knows where the weak points are before a single part is removed from the stockpile or the first weld is done.

Simulation is also useful with complex systems, such as robots, driverless transport systems or telpher lines. "There are so many factors influencing each other that

without simulation I, as a planner, can no longer comprehend them all," says Prof Axel Kuhn, assistant director of the Fraunhofer Institute for Transport Technology and Goods Distribution (ITW) in Dortmund.

The automotive giants are leading in this field, since it is there that automation has made the most inroads. But large companies in the textiles and household appliance industry as well as computer and machine building companies are also optimizing production using simulation. Still, it takes many years and plenty of money to develop complex simulation systems. Six years ago, the leading figures in the West German scene joined together to form the Working Group for Simulation (ASIM) and coordinate their research efforts. Today, the approximately 300 members include scientists, college instructors and engineers from industry.

Companies are also coming together to pool efforts. Bitter competitors such as Daimler-Benz and BMW, for example, are joining with VW and Siemens—in an Innovation Company for Advanced Production Systems in the Automotive Industry mbH (INPRO), founded in 1983—to develop a simulation system more tailor-made for automobile construction. The project is worth DM 13 million to the parties involved. The system should be ready for applications next year.

Medium-sized companies can scarcely manage without the help of third parties; they have no real use for simulation software off the rack. Thus, Hagener Luhn & Pulvermacher GmbH & Co., which among other things produces springs for trucks, is having ITW in Dortmund draw up a package suited to its needs. "We are continually forced to produce just-in-time. So we can't afford long set-up times for our expensive testing machines and a mountain of unattended-to orders," says production manager Detlef Spigiel, explaining his interest in the test process on the monitor.

With its help, the Westphalian automotive supplier hopes to replace time-consuming, traditional optimization strategies: "In this way, a great deal of expensive and tedious organizational research will be superfluous," says ITW researcher Kuhn, praising the electronic playground. However, he does also know "a large number of companies for whom the simulation experiment ended in a major disappointment."

The selection of the system alone can turn into a game of chance. There are now hundreds of suppliers worldwide, and prices are steep. Although simple simulators, which run on personal computers, are available beginning at DM 30,000 (including hardware), powerful systems with decent graphic support and connecting capabilities for design computers weigh in at DM 60,000 to 100,000, on a price scale that goes even higher.

The difficulties generally begin once the decision has been made to invest. For many companies, the output data is poor-quality. If the input assembly and start-up times do not agree, or the length of disruptions and their frequency are not taken into account, then even the most expensive system will spit out junk data. Or as they say in the field: "Garbage in, garbage out."

In addition, many people overestimate the capabilities of the electronic helper. "Simulation is no substitute for the creativity of the planner," warns ITW's Kuhn. Engineers and technicians must themselves select experiments, interpret results and draw the right conclusions. Because simulation, as ASIM people say to lower high expectations, "does the same thing for planning that a pocket computer does for solving a math problem." Any model is powerless against planless planners.

Another stumbling block: For many current systems, the simulation language and the control language for the assembly and logistics systems in the factory are not identical. "It would be ideal if we could take the diskette directly from the simulation to the assembly system," says Horst Anton Jakobi, project director for plant layout at Adam Opel AG in Ruesselsheim. "But unfortunately, we're not that far along yet."

For experts, however, this—and much more—will clearly be possible in the factory of the future. The vision: Instead of only running through individual substeps of production at the terminal, the entire factory, with all the right processes, is in the computer. In this way, it will be possible to know in advance the answer to questions such as, "What would happen if the volume of orders increases temporarily by x percent?" Fictitious orders then pass through the imaginary factory and are shipped out to the customer.

The Dortmund simulation experts are already working on this type of electronic prophet for Audi and Daimler-Benz. This will even influence the companies' long-term strategy. Using complete factory simulation, it can also be seen whether it is advantageous to produce a vehicle model at one site instead of at three different plants.

MICROELECTRONICS

FRG Laender Compete for JESSI Projects

36980177 Duesseldorf WIRTSCHAFTSWOCHE in German 31 Mar 89 pp 26, 29

[Article by Roland Tichy: "Research Subsidies: Everyone Wants JESSI"; first paragraph is introduction]

[Text] No one really knows what it is, but everyone wants it and is willing to pay a lot of money for it: The JESSI microelectronics program, worth billions of Deutsche marks, has become a bone of contention between the Bundeslaender. Instead of being a program promoting technological progress, it is threatening to become a master stroke of lobbying.

In Itzehoe, Schleswig-Holstein, the future is now—at least for the local hoteliers: "They've been booked solid for months," says CDU Bundestag deputy Dietrich Austermann. Occupied beds are the first economically tangible effects of the "Joint European Submicron Silicon Initiative," or JESSI. Thirty European companies—led by electronics giants Siemens, SGS-Thomson and Philips, as well as major users such as Daimler-Benz—hope, by 1996, to jointly develop the generation of electronic chips that will follow the next one.

The goal is an ambitious one: "Millions of jobs" in the automotive and mechanical engineering sector, in electrotechnology, optics and office technology will be jeopardized, according to the League of German Electrotechnicians (VDE) and the Association of German Engineers (VDI), if Europe is unable to regain the worldwide lead in the next generation of memory and switching elements, and in the generation following that.

The label "Made in Germany" found on many German high-tech products is deceptive, according to the industry association, self-critically. "They do often have German names on them—but two out of three contain imported chips." More important than their share of the net value, however, is the fact that users must provide the Japanese chip manufacturers with their special know-how, so that they can then imprint this systems technology in the conductor paths of the chips—and also pass it along to the German companies' competitors: thus, the threat that important information will be lost. In the "struggle of international competition, chips have long been the strategic weapons."

There should be no lack of money: According to current plans, around DM 10 billion will be spent on fundamental research, development technology, applied technology and the design of the necessary tools and materials. Around DM 3 billion is supposed to go to German companies, colleges and research labs—and Minister of Research & Technology Heinz Riesenhuber wants to generously add to this a billion from the state treasury. It is no wonder that a wild brawl has long been under way for the billions in research funding, even though a concrete working plan is still lacking, despite international pressure:

- In coordinated letters to the chancellor and federal minister for Research & Technology, the minister-presidents of Baden-Wuerttemberg, Lothar Spaeth, and Bavaria, Max Streibl, jointly lobbied for the greatest share of JESSI possible for the south.
- In contrast, Lower Saxon Minister for Economics Walter Hirche views the north as "the best prepared and predestined." The southern German Laender were at any rate using, he said, "flimsy arguments."
- North Rhine-Westphalian Minister-President Johannes Rau (SPD) has courted Chancellor Helmut Kohl for a JESSI subproject—and his minister for Economics, Reimut Jochimsen, asked the North Rhine-Westphalian CDU for support "in this important locational question crossing all party lines."
- Schleswig-Holstein Minister-President Bjoern Engholm attempted in the technology magazine HIGH TECH to dispel the impression that the Social Democrats are "marching through the country with red caps, waving flags and spreading anti-technology slogans." Even without having tested JESSI, he "wants to be involved."

In the long run, Engholm conceded, "one cannot live on low tech." Thus, JESSI should bring progress to a region that in past has not exactly been abundantly blessed with research facilities. In concrete terms, discussion centers around a research facility with a clean-room lab, where silicon technology, the basis of chip production, can be studied—at an investment price of DM 400 million and around 200 top-notch scientists.

Chances are not bad that this clean-room lab will go to the north, since most of the other labs where JESSI research will initially be carried out are in southern Germany. Minister for Research & Technology Riesenhuber already has a certain "preference for the north"—more precisely Steinburg kreis, coincidentally the electoral district for CDU Bundestag deputy Austermann. This is because the otherwise unobtrusive deputy, with skill and foresight, has maneuvered himself into rather unobtrusive but influential positions, so that scarcely a single chip can avoid dealing with his electoral district.

As the reporter in the Budget Committee for the minister for Research & Technology's budget, Austermann does not control the most important part of the budget in the Bundestag—but for the minister for Research & Technology, the man directing the flow of money is one of the most important contacts. Unobtrusively, the Riesenhuber/Austermann team has let funding for planned projects in the area of microelectronics build up. And the planning office that coordinates JESSI with industry and the funding sources in Bonn and Brussels was, with the support of the minister for Research & Technology, set up in Itzehoe—in an empty savings bank building. The secretary for the JESSI planners was temporarily borrowed from the Landrat, in order to lose no time.

The 1989 budget contains a provision for DM 195 million for the development of a new "central institute for silicon technology with clear-room lab." This is unobtrusively followed by the clause, "... at the site of the planning group, subject to agreement by the partners." "Who thinks about Itzehoe as the site of the planning group?" says Austermann, delighted with his coup. If the venerable senate of the Fraunhofer-Gesellschaft research organization plans to reconsider the necessity and location of the research institute now, it just so happens that one of the senators is named Austermann and will come from his electoral district in Itzehoe.

But success ensures no rest for the envious—and even destroys the solidarity of the northern German Laender. Because the Laender are supposed to cough up half of the investment sum of DM 400 million, Minister of Research & Technology Heinz Riesenhuber wants to wager on the party offering the most; Lower Saxon Minister for Economics Hirche promptly increased his Land's offer from 195 to 250 million in an attempt to lure JESSI to Hanover.

Frustrated, the southern German Laender are in turn playing an entirely different card—questioning whether such a clean-room lab is even necessary for the overall project. They are finding support in this from industry, which certainly wants to cash in on JESSI subsidies, but prefers to conduct its experiments in discrete company labs; in practical terms, such facilities are already planned for the southern German sites of the microelectronics industry.

The decision is thus back in Riesenhuber's hands. Unlike with previous chip developments, the minister this time does not want to simply turn over state funding to a corporation like Siemens. He is insisting that a joint, inter-company project involving state research facilities emerge—such as a clean-room lab. Because ultimately the minister has the budgetary controller from Itzehoe breathing down his neck. Austermann is clear about his intentions: "Without the clean-room lab, no money for JESSI."

JESSI Landscape: Potential German Sites for Research on the Superchip

Itzehoe	Institute for Silicon Technology (clean-room lab)
Hamburg	Philips/Valvo
Hanover	Laboratory for Information Technology
Berlin	Fraunhofer Institute for Microstructure Technology (until completion of the Institute for Silicon Technology)
Paderborn	CADLAB
St Augustin bei Bonn	Association for Mathematics and Data Processing
Erlangen	University/Fraunhofer Working Group for Integrated Circuits and Applied Electronics
Heilbronn	Telefunken Electronics
Stuttgart	Fraunhofer Institute for Production Technology and Automation; Institute for Microelectronics
Munich	Siemens

TELECOMMUNICATIONS R&D

RACE Projects and Proposals Outlined

Program Status

36980190 Brussels COMMISSION OF THE EUROPEAN COMMUNITIES in English 23 Jan 89 pp 1-3

[Text]

Research and Development on Advanced Communications in Europe

Background

Effective and cheap communication services are vital to economic performance and are therefore crucial to Europe's economic and social development. Already, more than half the jobs in Europe are related to information and services and involve the use of telecommunications in all its forms. Advanced infrastructures for information exchange and services will be as dominant in the latter part of the 20th century as canal, rail and road transport infrastructures were in the 18th, 19th and mid-20th centuries.

Development of digital electronic and optical technologies opens the way to greatly improved and economic voice, data and image communication. New technological developments include high definition television, digital recording and transmission of sound and pictures, optical fibres for very fast transmission of information, super-fast computers and satellite broadcasting. These will allow telephone and data transmission services to be brought together with video services to meet a large variety of needs.

Development of the RACE Program

A RACE Definition phase was set up in 1985 to plan a major programme of consultation, standards and technology R&D. It involved over 400 experts from industry, universities and network operators.

The Definition Phase established that there was scope and a need for a significant European effort to provide a framework for collaboration between network operators, industry, service providers and research centres. Progress was made in defining how integrated Broadband Communications (IBC) might be introduced, what a network would look like and what its various components would do. The economics of advanced telecommunications infrastructures and services were assessed and key issues identified.

The RACE program is focused on IBC and the development of technology for introduction of commercial IBC Services in 1995. It is an integral part of the telecommunications and standardisation activities of the European Community leading towards completion of the internal market in 1992.

The aims and objectives are:

—To create a climate of co-operation between Telecommunications Administrations and industry;

—To promote the competitiveness of the Community's telecommunications industry, operators and service providers;

—To make a major contribution to the introduction of Integrated Broadband Communication (IBC) Community-wide services in 1995, taking into account the evolving Integrated Services Digital Network (ISDN) and national strategies;

—To enable European network operators to compete under the best possible conditions;

—To enable a critical number of Member States to introduce commercially viable IBC services in 1995;

—To allow service providers to improve cost-performance and introduce new services;

—To make new services available at a cost and on a timetable at least as favourable as elsewhere;

—To support the formation of a single European market for telecommunications equipment and services;

—To contribute to regional development by allowing less developed regions to benefit fully from telecommunications developments.

The RACE effort lies in between basic research and market-oriented development. It creates opportunities for innovation in product design, development and manufacture, and reflects the realities of telecommunications operations, equipment manufacture, the need for evolution from current systems and the importance of cost. It is also concerned with the usability of equipment and services, and makes full use of the Community's intellectual resources in assessing requirements and in developing pilot applications.

Formal Decisions

RACE was adopted by the Council of Ministers in December 1987 and work started in January 1988.

The RACE program is a five-year program; from January 1988 to December 1992.

The total cost of the program will be over ECU 1.1 billion. Costs are shared equally between the participants in projects and the Community. The total Community contribution of ECU 550 million is included in the Framework program budget.

The Current Situation

Two general Calls for proposals have been made; in July 1987 and July 1988, and a restricted call was issued in April 1988.

Ninety proposals were submitted following the first general Call and 83 following the second. In both cases, the available funding was oversubscribed by a factor of about 3 and the coverage of the workplan was substantial but incomplete.

As a result of the first general Call and the subsequent restricted Call, 49 contracts were let and ECU 186 million was committed to work during the first three years of the program.

One hundred eighty-thee Organizations were involved in 1988. Within the EEC, 11 Telecommunications administrations, 41 universities and research organizations and over 120 companies, 24 of them small companies, are already involved in international consortia. Organizations from 11 of the 12 EEc countries are represented, and major U.S. companies established in Europe, such as IBM and AT&T, participate.

Organizations from other countries in the European Free Trade Association (EFTA) are also involved. Eighteen organizations from Austria, Finland, Norway, Sweden and Switzerland participate in 19 consortia and 13 percent of the work.

The work already engaged covers most of the tasks in Parts I and II of the RACE workplan. Part I concerns development of a consensus on strategies for evolutionary IBC introduction and on IBC functional system and sub-system definitions. Part II includes co-operative Research and Development on key technologies for the economic realisation of IBC equipment.

Part III of RACE, on functional integration and investigation of the characteristics of IBC networks and services, has been the main focus of the second call for proposals published in July 1988. The second call also concerned a few aspects of telecommunications network management, optical communication technologies and system verification not covered by existing contracts.

The second call closed on October 3rd 1988. Eighty-three proposals were received, 12 being expressions of interest to join a proposal for a European Testbed infrastructure. An independent technical evaluation of the proposals recommended acceptance of nine proposals and retention of 48 others subject to significant modification to bring them better into line with RACE objectives. Forty contracts have been negotiated.

Results and Progress

Over 100 reports and specifications have been produced in the first year. Considerable progress has been achieved in definition of a functional reference model for an IBC system. Opto-electronic technologies that will make widespread use of optical fibres possible have been developed. A much better understanding of the requirements for advanced communication equipment and terminals has emerged and new communities of service providers and users have been drawn into the program through the call for proposals for Application Pilots.

A first Independent Technical Audit of project activities has been completed. Of the 46 projects audited, 44 have been found to have achieved their goals for the first year. Difficulties in the work of one other project have been resolved and one project has been cancelled so that its work can be re-oriented and a new consortium involved.

A Strategic Audit of the situation in Europe related to development of advanced communications has been carried out. A report of the findings is available, and it is planned that it will be communicated to the Council and presented to the European Parliament in February 1989.

Projects, Proposals Listed

36980190 Brussels COMMISSION OF THE EUROPEAN COMMUNITIES in English 23 Jan 89 pp 4-8

[Text]

Existing and New RACE Projects[1] and New Proposals[2] Under Negotiation

Part I: IBC Development and Implementation Strategies

1045 Consensus management

Development of a functional reference model

1044 Functional Reference Model and customer service functions
1023 BEST—A methodological approach to IBC system requirements and specifications
1024 NETMAN—Functional specification for IBC management
1025 Functional specification of security and privacy in IBC

Development of reference configurations and evolution planning

1044 Functional Reference Model and customer service functions (Reference configurations)
1002 Satellite Communications for IBCN
1022 Technology for ATD; Hybrid systems
1026 International transmission of digital television and radio (Eurovision)
1028 Regional revolution planning for IBC (REVOLVE)
1035 Customer premises network (CPN)
1041 FUNCODE—Coding, service and interoperability for high-quality videotelephone and high-definition television (HDTV)
1043 Mobile communications
1053 TERRACE—TMN evolution of reference configurations for RACE [new project

Usage reference model development; Application analysis and opportunities for IBC:

1037 User criteria for IBC opportunities
1050 IBC Applications analysis (Phase 1, 1988)
1071 IBC Applications analysis (Phase 2) [new project]
1076 Remus—Reference models for useability specifications [new project]
1077 Usage reference model for IBC [new project]

Part II: IBC Technologies

Group 1: Networks and switching projects

1002 Satellite communications for IBC 1012
Broadband local network technology
1013 HDTV—switching
1014 Atmospheric; ATM and STM hybrids
1022 Technology for ATD
1043 Mobile telecommunications
1068 ROSA-RACE Open Services Architecture [new project]

Group 2: Optical communications

System projects

1010 Subscriber Coherent multichannel technology
1012 Broadband local network technology
1030 ACCESS—Advanced customer connection: an evolutionary strategy
1036 WDTM Broadband customer premises network
1051 Multi-Gigabit transmission in an IBC network subscriber loop

Active opto-electronic components

1027 Integrated opto-electronics towards the coherent multichannelIBCN
1029 Improved InP substrates for opto-electronic devices
1031 Low-cost opto-electronic components
1057 AQUA—Advanced Quantum-well lasers [new project]
1064 MIOCA—Monolithic integrated optics for customer access [new project]
1069 EPLOT—Enhanced performance lasers for optical transmitters [new project]

Passive opto-electronic components

1008 Silicon-based low-cost passive optical components
1032 Development and testing of optical components for subscriber networks (1988 only)

Optical switching projects

1019 Polymeric optical switches
1020 All-optical switching and bi-stable devices based on polymers
1033 OSCAR—Optical switching systems, components and applications

Group 3: Advanced information processing (AIP) and software engineering

Network management studies

1003 Guidelines—AIP and standards for Telecommunication management
1005 NEMESYS—Traffic and Quality-of-Service management for IBCN
1006 AIM-AIP application to IBCN maintenance
1009 ADVANCE—Network and customer administration systems
1024 NETMAN—Functional specifications for IBC management

AIP for customer service functions

AIP for integrity mechanisms; authentication, proof of origin and receipt, etc.

Program infrastructures

1017 IBC on-line environments
1021 ARISE—A reusability infrastructure for software engineering (off-line)
1046 SPECS—Specification methods, programming languages, testing and reusability

Group 4: IBC customer systems

Signal processing

1018 HIVITS—High-quality videophone and HDTV systems

Terminals:

1001 Digital video-tape recording for HDTV
1004 Electro-luminescent flat-panel display for terminal applications
1007 ITIS-IBC terminal for interactive services

Customer-premises networks (CPN)

1011 Business CPN 1015 Domestic CPN

Group 5: Usability engineering

1034 Usability engineering requirements for IBC (1988 only)
1038 Multi-media communications, processing and representation
1066 Integration of people with special needs with IBC [new project]
5001 Useability issues for people with special needs [new project]
1065 ISSUE-IBCN system and services useability engineering [new project]
1067 Useability design information support for the integration of IBC services

Part III: Functional Integration

Group I: Verification tools and techniques

1016 Test tools and equipment (1988)
1048 RSVP-RACE strategy for verification (1988)
5302 PROVE—Provision of verification [new project]
5302B QOSMIC—Quality-of-Service verification methodology and tools [new project]
5302C MIME—Development of emulators and simulators [new project]
5200 PARASOL—ATM-specific measurement equipment [new project]
1056 BIPED—Business IBC demonstrator [new project]
5212 Database for IBC reliability calculation [new project]
5202 BUNI—Broadband user/network interface demonstrator [new project]
1072 ITACA—IBCN testing architecture for conformance assessment

Group 2: Pilot applications

Banking, finance and insurance

1055 MERCHANT—Methods in electronic retail cash handling using advanced network topologies [new project]
1074 Electronic insurance-case handling in offices [new project]
1059 DIVIDEND—IBCN for the financial dealing sector [new project]

Health care:

1042 MULTIMED—Demonstration of functional service integration in support of professional user-groups
5117 MULTIMED extension (EFTA only) [new project]
5105 TELEMED—Definition and application of IBC facilities in the medical sector [new project]
5101 IBC for mental health care [new project]

People with special needs

1054 IBC support for people with special needs (the elderly and disabled) [new project]

Manufacturing

1039 DIMUN—Distributed manufacturing using existing and developing public networks
1079 CAR—CAD/CAM for the automotive industry [new project]
1058 RESAM—Remote expert system for aircraft maintenance [new project]
5309 SPIGOLO—Services for patent information by graphic on-line outputs [new project]
1073 GEOTEL—An IBC library service for the petroleum and chemical industries [new project]
1060 DIDAMES-RPA—Distributed industrial design and manufacturing of electronic subassemblies [new project]

Media and publishing

1061 DIMPE—Distributed integrated multi-media publishing environment [new project]
1070 Testing pay-per-view in Europe [new project]
0178 European museums network [new project]
1075 Telepublishing [new project]
1080 High-Definition Television experimental usage [new project] Transport:

1062 MARIN-ABC - Broadband communication with ships [new project]
1063 Mobile applications pilot scheme [new project]

Testbed infrastructures

5311 EBIT Service Project [new project]

N.B. Some projects appear in more than one part or group

Footnotes

1. New projects starting in January 1989.

2. Proposals under negotiation are indicated by a 500 series reference number.

COMPUTERS

Hungarian Software Market Evaluated

Trade in Experts Rather Than Products

25020241 Budapest NEPSZABADSAG in Hungarian 20 Mar 89 p 8

[Article by Katalin Magos: "Intellectual Slave Trade"]

[Excerpts] Our software export to the capitalist market has grown from 132 million forints six years ago to a billion (1,101 million) in 1988 and has become a determining part of our intellectual export. But a study published in February calls attention to dangers threatening the flourishing software export and leading to its decline. The largest item in our capitalist receipts is the export of manpower. [passage omitted]

But competition has already appeared in this area as well. While West Europe is flooded with young people from developing countries who have graduated from universities in the United States and Great Britain, and who speak English excellently, there are no replacements for the 400 or 500 domestic staff "capable of export." The experts from the large firms, trained at great expense, knowing the language and highly qualified, are going into the small undertakings for many times the wage while the "patron" activity at the large firms, in an ever more difficult economic situation, is increasingly paralyzed.

So software export will be forced to change. There is a need to increase the ratio of the still rare project export and the even rarer product export. The business success of the Graphisoft graphics software products and of the Compudrug chemical software products is a good example of finding the market gaps. The creation of mixed enterprises and even the opening of local Western representative offices could mean further progress in structural change.

The high taxes on intellectual activities in effect since 1988 have an unfavorable effect on development here at home. A strongly progressive tax weighs on the higher incomes achieved by the software export which is profitable for the national economy. It would be good if the organizations exporting software could get back a part of their foreign exchange income, which they could spend as they see fit on marketing, product introduction and acquisition of modern hardware and software tools. This is an indispensable condition for staying on the market.

The opinion of the two largest Hungarian software houses supplements this far from complete domestic picture.

In recent years the Computer Technology Research Institute and Innovation Center (SZKI), which leads on the export list, increased its annual capitalist export by 15-20 percent. In 1988 they exported for 255 million forints and 100 million of this was product sales. Despite the institutional wage grossification, the increase in travel costs and the devaluing of the forint their dollar yield moved between 28 and 44 forints. (The profit behind the numbers involves ideas obtained from foreign partners, recognition of world market needs and getting modern products to Hungarian users.)

Chief director Dr Zsolt Naray does not consider intellectual export, that is having an institute's development expert spend a shorter or longer time in a foreign creative community, to be a criminal activity. Of course, he should not do so as a software "clean-up boy." The chief goal for them also is to increase product export, but not in order to end the previous form.

The strategy of the SZKI is directed at increasing economicalness, building up a world scope marketing network and regular development of product families. Their goal is always to be on the market with five to ten world level products. The developmental tactic to achieve this is to adjust their work to the expected market needs 3-5 years hence. But in the absence of investment possibilities Hungarian software development, like Hungarian research as a whole, is in danger.

Miklos Havass, director general of the Computer Technology Applications Enterprise (SZAMALK), considers Hungarian software to be a good commodity. The firm's capitalist export last year exceeded 187 million forints. Proof of the good business is the average 16-20 forint dollar yield.

The director general is not so satisfied with the composition of export. Fifty percent of their receipts came from manpower export, half and half from sale of "niggers" and "teachers." ("Nigger" means that the intellectual capacity is sold without undertaking any responsibility, handing over the employer rights.)

The project work, making up a quarter of the enterprise export, is more favorable from the professional point of view. For example, the hourly wage of a Hungarian computer technician may reach 150 marks in the FRG. But lacking a suitable Hungarian trade chain only 60-80 percent of this reaches us.

The director general sees the conditions for increasing product sales, most favorable both professionally and economically, in a permanent market presence, a suitable computer background and good work morale. If these exist it will be possible to compete on the international market with user programs and special expert systems (e.g. geological and similar systems) independent of the economic environment.

But he considers it a sensitive point in domestic product export that often very ingenious Hungarian software is prepared but since the de facto standards are ignored,

standards developing as a result of programs being made in large series in a large industry manner, no one needs them because they cannot be interfaced with others.

Development of Capitalist Software Export

Year	Totals in Millions of Forints	As Percentage of Total Technical Intellectual Export
1982	132	13.6
1983	149	12.6
1984	182	14.6
1985	226	12.1
1986	434	27.3
1987	716	35.5
1988	1,101	38.9

Independent Authors Also Involved in International Trade

25020241 Budapest NEPSZABADSAG in Hungarian 20 Mar 89 p 8

[Interview with Gyorgy Palos by Andras Bencsik: "The Author's Rights"]

[Excerpts] Dr Gyorgy Palos, legal counsel in a main department of the Copyright Office, is also called upon to defend the authors of computer programs. [passage omitted]

NEPSZABADSAG: What sort of traffic does the Copyright Office handle in the area of software?

Palos: A great deal. Last year we signed 9,780 contracts and on the basis of these we paid 1,029 million forints in royalties. This is more than the royalties paid as a result of traditional works. The traffic is growing. A year ago it was "only" 606 million forints, so last year the total royalties almost doubled.

NEPSZABADSAG: Can you imagine a similar growth this year?

Palos: It is not probable. The market is slowly being saturated. There will certainly be growth, but hardly on such a scale.

NEPSZABADSAG: These data consist of the royalties of independent authors. What sort of traffic is there in the sphere outside your authority, in the enterprise sphere?

Palos: I cannot give data on that, nor on the foreign contacts of the enterprises and software houses.

NEPSZABADSAG: What sort of international traffic was there within the framework of the Copyright Office?

Palos: Last year we signed 149 contracts for foreign sale of software and the royalties taken in from these came to 76 million forints. It is worth noting that the great majority of the customers are American, English, French, Austrian and FRG partners, where computer technology, as is well known, stands at a rather high level. So the data speak for themselves.

NEPSZABADSAG: Do you all use a computer?

Palos: Yes, we do. Without it we could not do our work.

NEPSZABADSAG: Is the software needed for the computer a domestic or foreign product?

Palos: Domestic.

FACTORY AUTOMATION, ROBOTICS

Integrated Machining Production System Being Developed by Videoton

25020237 Budapest MAGYAR ELEKTRONIKA in Hungarian No 3, 1989 pp 21-29

[Article by Bela Sveda and Denes Papp, Videoton Electronics Enterprise: "A General Purpose Integrated Machining Production System at the Videoton Electronics Enterprise"]

[Text] An integrated machining production system is being realized at the Videoton Electronics Enterprise within the framework of the G/6 program of the OKKFT [National Medium-Range Research and Development Plan]. The authors describe the parts set of the manufacturing system and the machining technologies used. They outline the most important mechanical modules of the system and the computerized systems aiding technical preparation and guiding inventory record, production control and manufacturing processes.

The development of a general purpose integrated machining production system and putting it into operation has begun at the Videoton Electronics Enterprise during the Seventh 5-Year Plan. The OKKFT G/6 Program Office is offering significant material support for the development. The development has the character of supplemental automation. It is intended to improve the efficiency of the modern manufacturing equipment of the enterprise by the subsequent adaptation of various technical and organizational tools with the aid of a system of tools designated Integrated Material and Data Processing Systems (IAAR). The structure of the manufacturing system is modular, so the preparation, inventory and material movement system elements and the informatic system elements guiding these can also be adapted for similar systems of other manufacturers later.

Aspects of the Manufacturing System, The Developmental Goals

The general character of the manufacturing system to be realized is manifested in the inhomogeneity of the parts set to be machined, in the multiplicity of technologies used, in the different levels of automation of the shops

and in the different series sizes for different manufacturing batches. Along with the inhomogeneity apparent above the system is characterized by computerized control extending to every main and auxiliary process of manufacture.

The goals in creating the manufacturing system are to raise the productivity level of the entire production process, improve quality, decrease through-put times, improve utilization of the machines and reduce the ratios of routine intellectual work (administration) and hard physical work (material movement).

Another goal is to make the chief and auxiliary processes of manufacture easier to review, guide and organize by exploiting the possibilities of computerized control so as to filter out and eliminate factors holding up manufacture and decreasing efficiency.

Parts Set, Technologies Used

The manufacturing system is being built for the plant producing machined electromechanical parts for computer peripherals and other products of a mechatronic nature. Due to its profile the parts set and the technologies used are quite varied.

The weight of the parts ranges from a few grams to about 20 kilograms. The initial materials are rod stock, 65-70 percent, and light metal castings, 25-30 percent, the remainder being products of commercial origin. Small and medium series production characterizes the production volume. In general the annual number of units is 50-200. The number of workpieces processed is 5-700 annually. [As published.]

The technologies used in the manufacturing system are: turning, drilling, milling, grinding, tooth cutting, broaching, hand finishing, hand and mechanical burr removal, parts cleaning, traditional and automatic checking and packaging.

Most of the equipment in the manufacturing system consists of modern CNC machine tools which operate as robotized manufacturing cells as autonomous traditionally served work sites. The manufacturing system consists of about 65-70 technological work sites.

Structure of the Manufacturing System, the Most Important Mechanical Modules of It

The technological structure and physical elements of the manufacturing system can be seen in Figure 1. In what follows we will refrain from a detailed description of the structure and operation of the system; in this article we will restrict ourselves to a description of the most important mechanical modules.

Rod Stock Warehouse

An overhead view of the rod stock warehouse can be seen in Figure 2. The task of the rod stock warehouse is to store and keep records on the rod stock to be used and cut up the prescribed pieces in accordance with the production program of the manufacturing system. A loading machine (1) handles stock above 30-40 mm, one at a time, in an automatic mode, while material with a smaller cross section is placed in a box on the consoles (2). The robotized cutting cell (7) cuts up the rod stock which can be handled automatically. Serving the storage buffer (8) of the cell, removing the remnant material and loading the cut material into the designated storage box is automatic. The workpieces loaded in boxes and the chippings collected are moved by robot car (10) to the inter-operation warehouse or chip collection containers respectively.

We cut up the material with a smaller cross section on a semi-automatic cutting machine (6) with manual loading and manual programming. The crib saw (12) provides auxiliary functions.

The warehouse control computer guides warehouse functions and takes care of record keeping tasks; it has a line connection with the other computers of the local net of the manufacturing system, that is with the computers taking care of technological planning, production scheduling and production control tasks.

(h3)Inter-Operation Warehouse

An overhead view of the inter-operation warehouse can also be seen in Figure 1. The inter-operation warehouse maintains a bidirectional material movement connection between the manufacturing system and the external environment and takes care of buffer storage tasks for parts series in production in the period between the several machining operations.

A rack system (2) with a useful height of 12 meters takes care of the storage functions of the inter-operation warehouse; it is located in an area of the system with increased height. There are three computer controlled loading machines (3) belonging to the three warehouse corridors; by means of roller conveyor beds driven by their motors the loads go to the distributing car systems (4). There is a distributing car material movement system on the side of the warehouse served by robot cars and on the side operated manually. These are the units taking care of the input/output material movement functions of the inter-operation warehouse. The input/output traffic of the external units takes place on the manual operation side while on the automatic side, served by robot car, we handle the traffic directed toward the technological work sites. The internal work sites of the inter-operation warehouse are located on different levels above the area performing the manual serving.

At the palletizing work site the cut rod stock and castings arriving loose in boxes are reloaded onto so-called technological pallets 800 x 800 mm in size. The parts are placed on these in an ordered way making possible the machining of them at the robotized work sites.

Before being shipped to the assembly shops the technological packaging of the finished parts is done at the packaging work site. The task of the so-called assembly complement work site is to put together finished batches in the form of an assembly within the system and to put these on the technological pallets.

The task of the computer guiding the inter-operation warehouse is to keep inventory records, control the warehouse material movement equipment (loading machines, roller conveyor beds, distributing car systems) and to maintain contact with the other computerized subsystems via the local net of the manufacturing system.

Manufacturing Tool Warehouse

An overhead view of the manufacturing tool warehouse can be seen in Figure 3. The function of the manufacturing tool warehouse is to store, keep records on and provide ready for use the devices, tools, measurement tools and machine appliances used in the manufacturing system. The warehouse systems, manufacturing tool management work sites and internal material movement tools make up the mechanical system of the manufacturing tool warehouse.

In the warehouse the large manufacturing tools are stored on manufacturing tool pallets located in a rack system (1) similar to that in the inter-operation warehouse. This part of the warehouse is served by a "commissioning" loading cart (6). Small manufacturing tools are stored in a storage automat with a so-called pater noster system (2). The internal work sites of the manufacturing tool warehouse conform to this arrangement. The two sorts of manufacturing tools "commissioned out" from the warehouse are assembled and adjusted at the completing work sites (3) in the manner given in the technological instructions. A manufacturing tool set put together for one machining operation of one parts series is placed on a manufacturing tool pallet and handed over to the distributing car system (11). From here they go to the work sites with the aid of the robot car transportation system. The returning manufacturing tools are disassembled and cleaned at the same completing work sites.

The task of the quality control work site (4) is physical and informatics management of the input/output links of the system, continual maintenance of the databases and classification of the manufacturing tools. The manufacturing tool warehouse has its own sharpening shop where simple sharpening tasks occuring in large volume are performed (sharpening thread drills and milling blades).

The task of the computer controlling the manufacturing tool warehouse is to keep inventory records, scheduling for the warehouse work sites, control the warehouse material movement devices and maintain continual contact with the other computerized subsystems of the manufacturing system.

The Robot Car Transportation System

This takes care of the workpiece and manufacturing tool transportation tasks between the warehouses and technological work sites of the manufacturing system and it transports the chippings. The design of the transfer stands beside the technological work sites makes possible the automatic transfer of the pallets so the manufacturing tool and workpiece transportion functions within the system can be fully automated.

The traffic control subsystem of the robot car transportation system receives the transportation commands issued at the highest control level of the manufacturing system; then the established transport cycle is executed along the optimal path using the robot car in the most favorable location from the viewpoint of carrying out the task.

The Computerized Control System

The computerized control system guides the machining production system described above. We took the following into consideration:

—the mission of the system,—the requirements of the G/6 program,—the recommendations of the domestic and international literature,—facts and plans made known in connection with the CIM development strategy of the large electronics enterprises,—our experience gained with our sheet working production system,—the present and expected informatics environment of the system to be developed.

The basic principles of the system conception were:

—user oriented system design,—reliable operation,—modular construction of the system,—the modules should be transferable to a new organizational, technological, hardware and software environment.

The system is divided into three functional parts:

—the technical preparation subsystem,—the manufacturing organization subsystem, and—the manufacturing process control subsystem.

The tasks of the technical preparation subsystem are:

—to provide an interactive, graphic computer technology background for taking over the design documentation for parts, introducing modifications and standardization;

—in the interest of flexible production to support manufacturing planning for the parts by providing alternative paths, manufacturing tools, NC programs and basic materials;

—to follow the effect of technical changes on the technological documentation and in the preparation and production schedules;

—to provide simulation techniques to check the work of the technologists and to make possible use of the data produced in the factory and enterprise level subsystems.

The tasks of the manufacturing organization sybsystem are:

—to take over from the superior production control system and store the manufacturing orders scheduled with "decade [ten-day] precision" (Figure 4);

—to provide an interactive possibility for modifying the content or order of importance of the tasks filed;

—to prepare the fine static program in harmony with the time limits:

—for resources and subassemblies, —for the current and expected status of tasks in various combinations (product, work site, shop, shift, associated plant, etc.), —for the reality of being able to fit in new tasks, —for operations which have been delayed.

On the basis of the fine static program the subsystem guiding the production processes prepares and organizes its own activity:

—in the case of the warehouse, transport, commissioning and checking modules it provides lead time depending on the technological possibilities, as compared to the current need of the manufacturing processes;

—it selects the "most important"—in real time—from the list of tasks awaiting the several technological resources;

—it ensures the effective organization and execution of the preparation, storage, material movement and transport activities connected with the various warehouses, the up-to-the-minute administration of changes and operational control (various screen queries support execution);

—execution of the task running at the machining work sites and preparation for the next tasks overlap.

Structure of the Software System

The computerized information and control system of the machining production system includes a procedures system realizing the functions detailed above. This is broken down further into subsystems—strictly determined by one another and in close contact with one another.

The system is made up of the following modules:

—production scheduling,—static production programming,—dynamic production programming,—technology supply and distribution,—plant administration,—leader information,—process control,—rod stock warehous control,—manufacturing tool warehouse control,—inter-operation warehouse control,—transportation,—checking,—maintenance, and—manufacturing planning modules.

The sphere of authority of the manufacturing system does not extend to production planning; the system receives as input data the quarterly plan obtained by breaking down the longer range plan (e.g. the annual plan). Nor does design planning belong in the sphere of authority of the system and it does not determine the planning needs. All this is done by factory level production control. The factory unit production control system (Figure 4) will do the breakdown into short range (decade) plans and the manufacturing system will get the orders in this form.

The production control level of the software system of the manufacturing system maintains contact with the production planning and production scheduling levels of higher (factory/factory unit) production control; the remaining functions of production scheduling are realized here:

—capacity and material need studies,—determining the manufacturing tool need,—production programming produces the fine manufacturing programs pertaining to a shift (or day), scheduling the operations to be performed on the series of workpieces to be manufactured and assigning them to concrete production capacities. (At this point, naturally, one already knows the basic technological data; the requirement to prepare these is issued in advance by production planning for the subsystem performing automated technical preparation, which in part will be part of the manufacturing system.)

The fine programs prepared by the static scheduling module of production programming will be the basis for production. This will represent a provisional plan for manufacturing process control, for the main machine processes and for the associated inter-operation transport and storage. If the processes proceed according to the provisional scheduling then process control will work according to this plan for the entire shift (day). According to our experience with a previous manufacturing system this is so in the most rare cases. In general dispatcher intervention is not the way to manage an

upset in the schedule (due, for example, to slippage or machine failures), because the dispatcher cannot be put before a terminal for an entire shift as he has other tasks. (This also has proven true earlier.)

At such times the process control activates the dynamic scheduler which selects a task for process control from the fine program (or possibly from a wider set of operations)—according to its own algorithm.

So the task of the process control system is to execute with the physical system the manufacturing operations recived by one of the above methods and to track this execution. In the course of this it must carry out the following tasks:

—maintain contact with the production control system;—store and transport between sites the materials, manufacturing tools, products, etc.;—supply production sites with manufacturing documentation and NC programs;—supply production sites with manufacturing tools;—organize the inter-operation check of workpieces;—track the production, administration of changes;—organize possible maintenance;—organize and execute other ancillary tasks (removal of chips, handling auxiliary materials, etc.).

Tools for Realization (Hardware, Basic Software)

We intend to realize the computerized system primarily with computer technology tools developed by Videoton itself. A hardware configuration corresponding to the several software modules will consist of three networks which are connected with one another (Figure 5). According to the present plan the production control and process control networks will consist of VT160 computers and the manufacturing control network will consist of VT32 computers; a shop terminal may be used as a work site terminal where there are low communication needs.

We would like to buy the largest part of the system doing technical preparation as a finished program package; our own developmental task would be only adaptation to local conditions. The magnitude of the task, and the fact that for the time being we have very little experience in this area, justifies this.

We plan to develop ourselves the modules for the produciton control and manufacturing process control systems, based on our experiences, and we may bring in cooperation partners. Naturally we cannot exclude here either the possibility of buying a program package. [passage omitted]

Mechanical CAD/CAM Systems for TPA 11/500 Computers Described

25020236 Budapest MAGYAR ELEKTRONIKA in Hungarian No 3, 1989 pp 10-16

[Article by Bela Mohacsi, Measurement and Computer Technology Research Institute of the Central Physics Research Institute (KFKI-MSZKI): "Designing and Manufacturing Systems for the TPA Computer"]

[Excerpts] [Passage omitted]

CAD/CAM Systems at the KFKI

Since the middle of the 1970's the Central Physics Research Institute [KFKI] of the MTA [Hungarian Academy of Sciences] has been developing and manufacturing the TPA-11 computers. It has the task of supplying for its computers the basic software needed to run applications in an ever broader sphere. At the beginning of the 1980's a need appeared within the institute, and then from users as well, for supporting engineering designing work with computerized systems. But the 16 bit central unit and relatively small addressable operative memory meant a narrow cross section for development and use of CAD systems. It proved that development and efficient use of CAD systems was possible only on 32 bit machines.

The TPA 11/500 family of computers (TPA 11/510, TPA 11/520, TPA 11/540, TPA 11/580 and TPA 11/582) developed at the KFKI in recent years and having a 32 bit central unit does satisfy the needs of large CAD systems in regard to speed, memory and I/O capacity. Computers with similar parameters are used as the central computer in the majority of the world's CAD/CAM systems. The increased processor power makes possible the solution of computation demanding tasks within an acceptable time. The MOS-VP operating system also supports the writing and running of large programs. Our goal is to exploit the advantages of the new computer family and develop electronic and mechanical CAD systems which can be used widely by industrial and research and development enterprises.

At present we can offer our users four mechanical designing systems. The CAD-E and CAD-A support engineering design activity directly. The CAD-P is a system to prepare for finite element analysis and the CAD-F is a system to do the analysis. These are independent systems but by ensuring direct data traffic the possibilities in them can be better exploited. The two designing systems, CAD-E and CAD-A, stand highest in the hierarchy of the systems. Using one of these two systems the engineer builds a computerized geometric model of the workpiece, body or structure to be designed. The so-called IGES interface creates a link between the CAD-E and the CAD-A. The finished model can be handed on to CAD-P, which has a direct, bidirectional link to the CAD-F system doing the analysis. As graphics peripherals for these systems one uses Tektronix displays and Hewlett-Packard plotters, or devices compatible with them.

The CAD-A System

CAD-A is a CAD/CAM system supporting engineer design, drawing preparation, information management and manufacture; in the interactive mode the graphic screen can be put onto a plotter of optional size, thus the system offers a simple and efficient possibility for solving the drawing tasks which arise during designing. The built-in, "fast" procedures include simple geometric

operations such as enlargement and reduction, reflection, displacement, copying and rotation. This makes it possible for the engineer to make maximum use of the time spent before the graphic screen. A link can be created between the CAD-A and designing, analyzing and database management systems, which ensures the unity of design, information management, drawing preparation and manufacture. The CAD-A system offers broad support in the following areas:

—definition of geometric elements,—modification and grouping of geometric elements,—developing families of parts,—managing data files,—setting aspect and projection,—preparing technical drawings,—geometric analysis,—generating 2, 2 and a half, 3 and 5-D NC data, and—preparation of user programs.

The CAD-P System

The CAD-P is a general purpose interactive graphic pre- and postprocessor for creation and analysis of three-dimensional finite element models. With its aid one can perform the pre- and postprocessing which is an expensive, time demanding phase of work, most sensitive to errors, in the method of finite element analysis. With the program one can create directly, in an interactive mode, the objects which one desires to analyse (e.g., grid or shell structures and bodies) but these can also be taken from the databases of other CAD systems. The program generates the finite element net which can be further refined when one knows the result of the analysis.

Beyond creation of the geometric model CAD-P also makes possible a swift definition of the physical and material properties, edge conditions and load states. These are built into the database of the system. Various versions of the models can be analysed efficiently.

The CAD-P system offers the following services to the user:

—design, creation of the geometric model,—modification of the model,—optimization,—graphic display,—connection to other systems, and—post-processing.

The CAD-F System

CAD-F is a general finite element analysis (FEM) system which supports the solution of tasks arising during engineer designing work which cannot be formulated correctly with traditional dimensioning methods. These are:

—determination of the stress and displacement field in the case of static and dynamic loading, with linear or nonlinear material laws;

—determination of intrinsic vibrations and frequencies;

—a study of transient temperature fields and those constant in time;

—break studies; and

—static and dynamic study of pipe systems.

The CAD-E Designing and Manufacturing System

CAD-E is a general purpose, interactive, 3-dimensional CAD/CAM system suitable primarily for solution of mechanical and architectural tasks. It covers problems arising during designing and manufacturing planning such as geometric design, simulation, documentation, preparing technical drawings, planning the machining process, etc.

CAD-E is an open system. Its services can be expanded to suit user needs and the given application. It can accept computational procedures already used at the site of installation and can keep up with the development of the using enterprise.

The basic principles of the system are as follows:

Uniform Description

An efficient CAD system must cover problems arising during design and manufacture such as geometric designing, simulation, prepartion of documentation and technical drawing, planning the machining process, etc. This far-ranging system of requirements can be satisfied only based on 3-dimensional modeling.

Flexibility

Designing is a process dependent to a great degree on the character of the application, which changes from enterprise to enterprise and from time to time. So a CAD system must be open. It must be capable of accepting computation procedures used at the site of installation and of keeping up with the development of the using enterprise.

Portability

In computer technology the development of hardware is swifter than that of software systems. So it is essential that CAD systems have portability, that is, they must be independent of the hardware.

Three-D Modeling

The parts or objects to be designed are by their nature 3-dimensional forms while the traditional tools used in designing (paper, drafting table) are 2-dimensional. CAD-E is not only a system supporting preparation of drawings; it is not stuck at the functions of an "electronic drawing board." It satisfies the far-ranging requirements which arise by being based on 3-dimensional modeling. This suits better the way an engineer thinks, because when he designs a workpiece and imagines it before him he is thinking in terms of 3-dimensional space and not in terms of front and side views. Use of the CAD-E system puts an end to the "2-dimensional constraint." With its

aid, sitting before the graphic screen, one can make a 3-dimensional geometric model, in the conversational mode, which has properties corresponding to the imagined workpiece. The model created can be easily modified, transformed, made more precise, taken apart, built further, etc.

Coherence

Another great advantage of 3-D modeling is that one can obtain from the same virtual model the data needed in the course of the designing or manufacturing processes—for example to produce the technical drawings or the NC control programs—the model being the unique carrier of the geometric information. Thus later modifications need be done only on the original geometric model.

Easy Use

Every member of a design team (the engineer, the technician, the draftsman) must know how to use the given CAD system. So a designing system must ensure conversational mode possibilities, interactivity.

Structure of the System

An outline of the structure of the CAD-E system can be seen in Figure 2. The interactive CAD-E, with the aid of which work proceeds in a conversational form, consists of two parts: the basic system and the user modules. The interactive basic system provides the entire set of tools for 3-D geometric modeling; its services can be expanded without limit by adding user modules.

During operation the interactive CAD-E (both the basic system and the user modules) works into the so-called data structure, which is a previously reserved area of the memory of the computer. The content of this can be saved to the database which can be found on magnetic disk.

The expandability and great adaptability of the CAD-E system is guaranteed by the fact that the user can write programs satisfying his special needs in the CAD-E program language. This is a geometric, graphic language which works with the high level programming language Fortran, functioning as an expansion thereof. The programmer can define geometric bodies and surfaces, can perform various operations and computations on them, can prepare drawings, etc. The language is the same and in certain cases it provides the user with more extensive geometric modeling possibilities than the interactive system. This is how the user modules were made, and can be made; these modules expand the services of the interactive basic system. These so-called batch programs can also be run on an alphanumeric terminal, independent of the interactive system.

The auxiliary programs make up the third large group of programs belonging to the CAD-E software system. These serve primarily to create, manage and maintain the databases.

After setting the values for the parameters determining the operation of the system the actual interactive work can begin; this consists of creating the 3-D and 2-D geometric elements and models or calling up old stored objects and modifying them. This work always takes place in the memory of the computer, in the data structure. When the work is finished the objects created (which can also be non-geometric data) can be saved and stored in the database of the system.

The system is menu controlled. The designer can select the commands appearing on the screen with a freely moveable cross hair. The commands are grouped functionally (e.g., creating elements, managing visibility).

With the modules of the basic system CAD-E supports geometric modeling, display, manufacture, database management and engineering computations and covers a significant part of the geometric design process.

Geometric Modeling

Simple and complex geometric structures consisting of 2-dimensional geometric elements and 3-dimensional bodies can be created and these will have the geometric properties of the object to be modeled. This is the so-called virtual model, which can be changed somewhat and further modified with the aid of geometric and topological transformations.

Providing Data

All geometric data (value of coordinate, radius, angle, etc.) can be given in various ways—numerically directly from the keyboard, on the screen graphically with the aid of the cross hair or in the raster mode. The geometric elements can be defined in space or in any projection plane.

Basic Elements

Points, straight segments, circles, arcs, polygons, roundings off, breaks, loops, combined lines.

Surface Elements

Planes, plane figures, prismatic surfaces, rotation surfaces, guided surfaces, tube surfaces, polyhedral surfaces and complex, free form surfaces.

Spatial Elements

Prismatic bodies, rotation bodies, tube bodies, polyhedral bodies and complex bodies defined by free form surfaces.

Transformations

The geometric model created with the aid of the methods outlined above can be modified or transformed. The transformations can be geometric and topological transformations.

The geometric transformations naturally include the well known simple transformations: copying, displacement, enlargement, rotation and reflection. In addition the user can define his own transformations which thereafter the system handles together with the simple transformations. The system makes it possible for the user to perform several geometric transformations in one step.

The topological transformations put an efficient tool in the hands of the user for developing complicated, compound forms and bodies. In essence these are set operations: extraction, unification, creating a common part and producing sections.

Display

The form or object to be studied can always be displayed on the graphic screen during the designing work. The CAD-E system offers for this purpose a broad scale of display modalities in the interactive mode:

—Simple, orthogonal projections: front, back, above, below and side views.

—Axonometric views.

—Conical, cylindrical or spherical perspective ("fish-eye optics") views. (The location of the observer and the direction of observation can be modified.)

—Zoom and enlargement possibility. During interactive work one can change as one likes the dimensions of that window through which the user views the geometric model and which is displayed on the graphic screen. Any part of the drawing can be enlarged.

—The graphic screen can be handled flexibly and can be divided into a number of parts. This makes it possible for the user to work simultaneously in 1, 2, 3 or 4 views.

—Hidden line depiction in the system. This is not a superfluous luxury but directly serves the needs of the designer.

—Using color raster graphic displays it is also possible to have shadowed depiction of 3-dimensional forms.

—Display on a plotter. Within minutes every image which can be seen on the screen can be displayed on a plotter attached to the system.

Support for Manufacture

The geometric model (virtual model) built up with the CAD-E system is a full simulation of the object to be constructed. It contains all the information needed for the essential, actual production of the body. This information supporting manufacture is available in two ways, on the one hand as technical documentation, a technical drawing, and on the other hand as the control program for an NC machining tool which produces the workpiece.

Preparing Technical Documentation

Placement of the dimension net is semiautomatic. From the geometric model built up previously the system calculates the precise values of the size but the user takes care of placing the dimension line. The system supports the drawing of the dimension line types arising in the course of preparing the technical drawing. Its symbol library contains the most important technical designations (tolerances, surface quality, concentricity, etc.).

Preparing the NC Control Programs

The CAD-E offers powerful support for preparation of the NC program which machines the modeled part. It supports lathing, drilling and two and a half and three axis milling operations. The NC programs for the machining tool paths generated by the system can also be produced in several programming languages (APT, EXAPT, PROMO, COMPACT, etc.). The tool paths can be displayed, supporting the work of the NC technologist.

Analysis

The analysis functions of the system make possible a further check of the part or geometric model during designing, going beyond simple display. This function is open and can be expanded with additional test possibilities depending on the application.

—The coordinates of points, radius of circles, angles, distances, etc. can be queried after identification on the graphic screen.

—The system automatically computes the length of lines and curves, surface areas, volumes, mass, centers of gravity, inertial forces and main axes.

—In addition to a visual check it is also possible to check the possible coincidence or overlap of two objects.

User Modules

The user modules are programs written in the CAD-E program language which expand the services of the interactive basic systems. The user also can prepare such modules, making the CAD-E system suitable to meet his own special needs. The services of the most important user modules are the following:

—printing out the content of the data structure,—defining the color table in the case of a color raster screen,—compiling large scale geometric models,—creating parallel spatial elements,—defining letter types,—an NC-EXAPT interface,—two and a half axis NC machining,—three axis NC machining,—defining tools,—a FEMGEN interface,—an IGES interface,—a VDA interface,—schematic design,—handling Bezier curves and surfaces,—topological analysis,—parametric designing,—studying kinetic chains,—designing laminar parts,—architectural designing,—DIN normatives and standards,—HASCO standard parts,—preparing parts lists.

Industrial Applications of CAD/CAM Systems

We began to put the CAD-E, CAD-A, CAD-P and CAD-F designing systems into operation in 1987. TPA 11/580 computers and these designing systems provide the basis for the model CAD/CAM systems set up in the Mechanical Engineering School of the Budapest Technical University and at MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences]. Among our industrial enterprises we set up TPA based CAD/CAM systems in the RABA Hungarian Car and Machine Factory, the Hungarian Optical Works, UVATERV [Road and Railroad Planning Enterprise] and Tungsram.

Introducing CAD systems into an industrial environment is not free of problems. Results can be achieved only with well trained, enthusiastic experts who know how to use the new tools, people who do not recoil from the initial failures. In our introduction we already mentioned that CAD does not automatically solve designing tasks, rather it only supports the work of the engineer as a tool. Use of CAD systems is made difficult by the fact that there must be changes in the traditional designing methods, which can conflict with the organizational, personnel structure which has developed at the enterprise.

Of our industrial users the Hungarian Optical Works and the RABA Hungarian Car and Machine Factory have achieved real success in using the designing and manufacturing systems. (The other enterprises began to use the system in recent weeks.) For the sake of the example let us become acquainted with the CAD/CAM system put into operation at the MOM [Hungarian Optical Works].

The CAD System Developed at the Hungarian Optical Works

The thousandth TPA computer was handed over at the Hungarian Optical Works in May 1988 in a festive atmosphere. The task of the hardware and CAD-E designing system put into operation was to accelerate technical development at the MOM, shorten the time between product prototype and large series production and naturalize the culture of computer aided technical design. The configuration was as follows:

—a TPA-11/540 and TPA-11/580 central unit,—two 320 Mbyte hard disk stores,—80 Mbyte exchangeable disk store;—a magnetic tape unit,—a line printer,—an A0 plotter,—VDX alphanumeric terminals, and—two graphic terminals.

An Olivetti PE 28 computer, IBM PC/AT compatible, serves as graphic terminal; it has a high resolution graphics card and color monitor on which one can run software emulating Tektronix terminals.

The system is used to solve tool design tasks (cold forming, injection molding, die casting). The choice fell on this area for several reasons. On the one hand the appearance of a product on the market can be significantly accelerated with fast and especially error-free designing of valuable tools and preparing for NC machining. On the other hand, since tools are made up of a few complex parts and standard elements, the methodology and methods for designing were already developed on the basis of several decades of experience.

They have already tested the CAD-E system on the solution of a number of tasks. The most significant of these was designing a die casting tool for manufacture of a telescope housing having a very complex geometry. In the course of this they used every possibility of the designing system. The result was not only spectacular (it can be seen on the cover) but it also called the attention of the designer to a number of deficiencies which probably would have been discovered only in the course of making the tool in the case of manual designing. For example, these included an uneven wall thickness in the die castings, an error in the relative position of drill holes and simple computational errors. After performing the set operations between the body judged to be error free and the elements called from the standards library they produced the most sensitive parts of the tool, the elements giving it form. From this they produced the shop drawings, preparing sections, mountings and various views.

At the MOM they do not use the CAD-E system only for designing; they have matched their NC modules to the wired spark machining and NC machines of the enterprise.

Summing Up

The TPA-11/500 series computers of the KFKI and its CAD systems described in this article have creted for Hungarian industrial enterprises also the possibility of catching up to the European front rank in designing and manufacturing their products.

I began this article with a quotation from the book by J. J. Marchant titled "Computerized Technical Design." I close by repeating the same words, supplemented with another quotation:

"...The survival of no enterprise can be guaranteed without CAD tools and in the future it will not be possible to preserve competitiveness with traditional designing methods alone." "But neither should one expect immediate results from putting into operation a single computer aided designing or drafting tool. It may require nearly two years before one can fully exploit the advantages of the tools available."[passage omitted]

Hungarian CAD/CAM Developments Described

Teaching, Research Network at Heavy Industry University Discussed

25020240 Budapest COMPUTERWORLD/ SZAMITASTECHNIKA in Hungarian 18 Feb 89 p 5-6

[Article: "Computer Network of the Mechanical Engineering School"]

[Text] The Mechanical Engineering School of the NME [Heavy Industry Technical University] bases teaching and research on a considerable computerized network. They laid 20-wire cables with a radiating topology starting from a TPA-1148 computer in order to reach every faculty of the school, a few mining and metallurgy faculties and other significant institutions of the university such as the central library and some laboratories. The cables virtually knit together the teaching buildings of the NME. The soul of the system is a switching cabinet in which one can link the wires of any remote terminal to the wires of any other terminal, thus the terminals can be gathered in a loop or point-to-point connections can be made. On this basis they have been working for 3 years on a good quality, flexible, multipurpose remote data processing net.

In the past year and a half the faculties have obtained a significant park of computer technology tools, especially in the CAD/CAM area. A computer technology laboratory has been set up in every faculty; to an overwhelming extent the resources consist of 16 bit computers and graphics peripherals. A total of 25 AT's and three XT's are connected to the computer center. One computer has an XHR high resolution graphics screen; two have A/0 size plotters and seven have A/3 size plotters and there is a total of five A/3 size digitizing tables. The school also has one Tekemu and one Sysgraph graphics work station. They have installed in the laboratory of the Mechanics Faculty a terminal of the national infrastructure network for scientific research and technical development (IIF); from this they can reach the Academy network and, through the NEDIX system of the central library, they can also query foreign databases.

Model CAD/CAM System at Budapest Technical

25020240 Budapest COMPUTER WORLD/ SZAMITASTECHNIKA in Hungarian 18 Feb 89 pp 6-7

[Article by Gitta Takacs: "Model CAD/CAM System at the Technical University"]

[Text] It was decided a year and half ago to establish a model CAD/CAM system at the Budapest Technical University, using funds of the G/6 program for research and development on manufacturing automation. Those responsible voted 66.5 million forints for acquisition of new tools and 15 million for operating costs (see our issue No 9, 1987). Since then they have purchased a large part of the new computers, software, NC machines and robots, have built, with several months of assembly and testing work, an Ethernet network winding among the university buildings, have struggled with numerous compatibility problems, etc. And although the model system is not yet entirely finished one can already read in the university schedule of classes that teachers and students alike are becoming acquainted with a "beautiful, new engineering world."

The basis for the university's model CAD/CAM system is formed by a central network—coaxial cable—which links the Informatics Laboratory with the machine shops of the Machine Manufacturing Technology Faculty. Attached with DECnet control software to the Ethernet network, with a transmission speed of 10 megabits per second, are TPA and other VAX compatible computers, Novell subnets consisting of IBM PC compatible computers and sometimes directly—with appropriate interfaces—individual PC's or graphics workstations.

On the Ethernet Main Line

One "end" of the main line network is the TPA 11/580 megamini computer—with a 1.5 gigabyte background—located in the Informatics Laboratory; this is the control computer for the network and the CAD software requiring much computation is run on it also. The other "end" of the main line network is the CAM subsystem with the cell controls.

Working out the access and jurisdiction principles and methods was a very essential part of building the model system. A number of resource computers work in the system so it was important to identify the users and unambiguously assign their authority. Colleagues from the BME [Budapest Technical University] Informatics Laboratory and the KFKI [Central Physics Research Institute] built on the basic services of DECnet and developed a record keeping system which they will also provide to other domestic industrial enterprises interested in introducing similar, integrated CAD/CAM systems—in accordance with the original purpose of the model system.

The largest of the subsystems is the CAD teaching laboratory established by the OMFB [National Technical Development Committee]. The Novell network consisting of 16 PC's has been working 12 hours a day since February 1988 in the service of instruction.

Parts for designs made with the CAD software can be made on the manufacturing cells of the Machine Manufacturing Technology Faculty and the Mechanical Technology and Material Structure Institute; domestic and foreign CAD/CAM programs acquired can be tested, or further developed, in every phase of operation; they can be "made to order" for a domestic enterprise; and the training or further training of enterprise users can be done at the Technical University.

Robots in the Cells

In the near future they will put into operation in the CAM subsystem a high power graphics workstation for technological planning and preparation of NC control programs. A supermicro computer for this purpose alone will guide the experimental manufacturing system; it will be connected to the Ethernet network and will maintain contact with the cell control units. System control and/or NC programs produced with systems at a higher level in the "hierarchy" will reach the robots and machine tools of the manufacturing cells through this computer.

The manufacturing system consists of five cells—machining, storage and transportation, testing, assembling and premanufacture cells—which are controlled by the software of a FLEXCELL cell control from the Flexys company. Working in the machining cell are an EEN 400 lathe and TC3 processing center from the Machine Tool Industry Works, a portal robot from the Rekard machine factory in Gyor and a FANUC M3 cylindrical coordinate robot.

Axle and disc type parts can be processed on the lathe. A cart moves material between cells, carrying the pallets or flats transporting the axles to a storage area in the vicinity of the lathe or processing center. The two robots perform the other operations. Movement and replacement of the tools and appliances is not automated.

The Roboplan enterprise prepared the technical plans for the storage and transportation cell. The configuration, consisting of robot car, one story warehouse, receiving-storage tables and roller beds, serves all the cells. The basis for the testing cell is an OPTON UMC coordinate measurement machine. The part reaches the roller bed of the air conditioned testing site through an air lock. This testing cell will have an important role if the cell control and the NC software make it possible to use the test results for very precise manufacture.

For the time being the assembling cell figures only in the plans. The Technical University does not yet have the high performance robot which would be needed for fully automated subassembly manufacture. Until one is acquired they will be testing installation and use of smaller robots, assembly peripherals, feeding devices, image processing systems and sensors for the future assembly cell and will work on connecting these into the system.

The premanufacture cell, on the other hand, already has a working welding module based on a welding robot made by the Rekard factory in Gyor on the basis of an Austrian license.

New Study Plans and Programs

They have tried to collect all the more important domestic CAD programs in the Informatics Laboratory and in the CAD teaching PC laboratory. Teachers and students alike can learn how to use the CAD-A, CAD-P and CAD-E geometric designing systems of the KFKI, the 3-dimensional FFS surface modeling and designing system developed at the SZTAKI [Computer Technology and Automation Research Institute] and the programs of the Industrial Technology Institute. A number of PC programs for CAD and to produce NC controls have been prepared at the Technical University as well. We might mention as an example the FAUN system developed by the Machine Manufacturing Technology Faculty; it is suitable for planning the 3, 4 and 5 axis machining of workpieces containing complex surfaces. With the TUSY-TU program one can plan the lathe operations for axle and disc type parts and with VULKANUS one can design a manufacturing technology for rotation symmetrical die tools. In the Textile Technology and Light Industry Faculty they have adapted a cloth designing program package; in the Water Machines Faculty they have prepared a program to design pump wheels and calculate pipe networks; in the Technical Mechanics Faculty they have prepared finite element programs for instructional purposes; and the list could go on.

The computerized main net brings the university's schools and faculties closer not only physically but also "intellectually," encouraging them to work together. The study plans now include various courses and classes teaching computer technology at a level substantially higher than BASIC. The greatest change will be in the Mechanical Engineering School. Beginning in September mechanical engineering students will study informatics subjects for six semesters—they will be able to study them, because finally the hardware and software are available for it. Beginning with the seventh semester they can choose to specialize in mechanical automation and mechanical informatics.

Raba Factory Takes the First Steps

25020240 Budapest COMPUTER WORLD/ SZAMITASTECHNIKA in Hungarian 18 Feb 89 p 7

[Andras Dusza: "The First Steps; CAD/CAM at Raba"]

[Text] The Raba Hungarian Car and Machine Factory in Gyor was among the first in Hungary to begin to build a machine industry CAD system. The central machine is a

TPA 11/580 computer from the KFKI with 16 megabytes central memory and 1.2 gigabytes online accessible background storage. Probably this year they will convert the system to a two processor one and increase its memory capacity. At present it has four high resolution color graphics workstations, supplemented by six alphanumeric terminals, but there will be more of these too.

In the near future they will install in the Raba tool factory unit a Droop and Rein three axis CNC milling machine which will be the first CAM link to the CAD system. The AT compatible computer belonging to the milling machine will control the processing machine with a DNC connection. In the interest of interference-free data transmission they have used a glass fiber cable connection—something still new in domestic practice. For the time being the control PC of the milling machine will remain in offline contact with the TPA running the CAD system; it will be switched to online only later.

What experiences can one gather from the operation thus far, only six months? Who is in contact with the CAD/CAM system at Raba, and how? Istvan Pinter, chief of the CAD/CAM group at Raba, is satisfied: "After very long and basic preliminary studies the first eight engineers could sit down before the screen. They studied the basics at study courses organized by the KFKI; since then the designers and technologists have spent 4 hours per week each, partly with exercises and partly doing their own designing work on the computer.

"Raba also established its own CAD/CAM training center (see our issue No 7, 1988—the editors) where the expert staff of the factory is continually being trained. So far we have had no basic problems with the computerized system. The KFKI fixed minor failures in the computer within 1-2 days; for our other suppliers this took a little more time. The CAD-A surface modeling program package of the KFKI can be well used here too. It is not perfect or complete but it is a 'seed' from which we must grow a 'tree bearing fruit.' To do this we must decide what it is worth while to design with the computerized system, and how. We may have some problem with follow-up on the software, but this is not only our problem."

In any case the Gyor factory has had several decades' contact with mammoth American firms ruling the world market. There is not only seller-buyer contact with some of these; technical development cooperation is developing as well. For example, experts from the Eaton Company have already asked the leaders of Raba if they would be able to participate in their global communications system. Raba's answer was "yes" so the Eaton test data file consisting of technical documentation will soon arrive from the United States. Hereafter the technical drawings and information which previously arrived on paper or telefax will be received on magnetic disk and will be processed with the TPA computer.

Videoton's CADNET System Described

25020244 Budapest MAGYAR ELEKTRONIKA in Hungarian No 3, 1989 pp 17-20

[Article by Janos Czupy and Lajos Gacs, Videoton Developmental Institute: "CADNET—Computerization of Engineering Design"]

[Excerpt] The CADNET network developed at Videoton offers a complex solution in the area of computerized designing. The article describes the goals, basic principles and chief elements of this network. [passage omitted]

The CADNET System

The CADNET complex computer technology system of Videoton provides tools for the solution of all tasks arising in engineering design offices. The tasks of a planning office employing 10-100 workers, located not too far from one another physically, can be solved with a modern, high-speed local network system employing the optimal computer systems for the given purpose.

The CADNET system offers complex service in every phase of the engineering design process:

—a possibility to input and process graphic information;—engineering design work done with interactive graphic tools;—use of common databases, libraries, etc. accessible to everyone;—running of dimensioning and checking programs;—performing computation intensive simulation tasks;—integration of partial design results;—common storage and archiving of large volumes of information;—provides interfaces needed for computer aided manufacture (CAM);—a possibility for serving integrated data and material processing systems (CIM);—support for documentation preparation;—a business, office interface, electronic mail;—connection to traditionally widespread data processing systems.

The basic element of the CADNET system is the so-called workstation which makes interactive graphic design possible. The workstation makes significant computer capacity, high resolution interactive color graphic tools and peripherals available to a single user. So the graphic workstation is a tool for maximally efficient engineering design.

The CADNET system contains complex, general purpose and special hardware tools and peripherals and basic and applications software systems. By using these tools one can create workstations and special computer configurations optimally solving a given task which we call server stations.

A high-speed local network system makes possible information exchange between server stations and workstations.

Basic Types of Servers

—The "job server" is a high-speed computer for computation intensive tasks optimized to run simulation programs.

—The "file server" is a computer providing significant background storage capacity to store, manage and archive the jointly used databases of CADNET.

—The "peripheral server" is a special purpose computer aiding common, economical use of special, very valuable peripherals.

—The "communications server station" provides communication with CADNET systems located farther from one another geographically and with ESZR/ MSZR [uniform mainframe and minicomputer] computer systems.

—The "documentation server station" is an efficient tool to produce the technical and nontechnical documentation, descriptions, etc. produced in the course of engineering design work.

The high-speed local network communication between workstations and with servers is of special significance. Complex designing work requiring a number of part activities is supported with the following possibilities:

—Exchange of parts of plans among designers, information flow within the designing process.

—Use of designing standards and the checking of these.

—Integration of partial plans and partial results.

—Connection with manufacture (NC control).

—Production of production control information and transmission of it to production control computer systems.

Elements of the CADNET System

The CADNET system is based on the VT32x computer family of Videoton. It consists of computers which can be built up from modular basic units and the configuration accomodates flexibly to the user's needs.

The VT32, VT320 and VT3200 are members of the VT32x family with different power; they can form a common communications system and are software compatible with one another. Based on these computers one can build the following workstations or server stations.

Graphic Workstation

The VT32x-GS graphic workstation can have a central unit supplied with a high power 16 or 32 bit processor and optional cache and arithmetic circuits. The capacity of the main memory is 2-16 Mbytes. The intelligent background control system can control a floppy disk unit, a tape storage unit and large capacity disk units.

The graphic system can control a 19 inch, color, high resolution graphics monitor with a pixel resolution of 1024 x 768 or 1280 x 1024 to display 16-4096 colors. In addition it can handle a "tablet" positioning device and an A3-A0 size plotter.

The computer is based on an esthetic and ergonomic design suitable for an office environment.

The structure of a typical graphic workstation based on a VT320 is as follows:

—16/32 bit central unit with cache and hardware arithmetic;—4 Mbytes main memory;—0.72/1.2 Mbyte floppy disk unit;—20 Mbyte tape storage unit;—120 Mbyte useful background capacity;—VT220 compatible alphanumeric terminal;—1024 x 768 pixel resolution color monitor;—NLQ matrix printer;—900 line/minute speed line printer;—A3 size six color plotter.

File Server

Like the graphic workstation the VT32x-FS file server can have a central unit with a high power 16 or 32 bit processor and optional cache and arithmetic circuits. The capacity of the main memory is about 2-16 megabytes. The unique feature of the intelligent background control is that in addition to the usual floppy disk and tape storage units it can also control very high capacity disk units. The machine also offers an optional possibility for handling magnetic tape units.

The mechanical design can be suitable for a computer room or an office environment.

Communications Server

The VT32x-CS communications server can also have a central unit supplied with high power 16 or 32 bit processor and optional cache and arithmetic circuits. The capacity of the main memory is 2-16 megabytes. The intelligent background storage control system can handle a floppy disk unit and large capacity disk units.

The unique feature of the communications server station is the many-layered communication service offered by it. In addition to the services of the local network it provides the following possibilities:

—a 4 Mbyte/s ESZR channel connection;—BSC, SDLC, HDLC, KERMIT and ESZR/MSZR serial line connection;—MSZR 8 bit parallel connection.

The mechanical design can be suitable for a computer room or an office environment.

Peripheral Server

In addition to the customary characteristics of the computers of the network the VT32x-PS peripheral server offers to all stations in the network the services of the special peripherals handled by it. These can be primarily the following:

—NLQ matrix printers;—300-900 line/minute line printer;—laser printer;—A3 size plotter (or plotters);—A1 size drum printer;—A0 size drum printer;—photo printer;—punch tape or other peripherals to produce NC controls.

The Software System

The services of the software system running on the CADNET system appear at two levels corresponding to the needs of the basic task to be solved. In the first place it offers turnkey tools to solve a few designing tasks considered most typical by Videoton. These areas are being expanded with time in accordance with market possibilities. On the other hand it provides tools and a developed environment for developments by the user.

The applications systems now in existence or to be prepared in the near future embrace the following areas:

—design of highly complex pipe systems,—design of modern multi-layer printed circuits,—design of equipment oriented integrated circuits,—design of mechanical drive systems, and—a 3-dimensional graphic editing and modeling system.

Naturally the CADNET system cannot be regarded as a closed system "frozen" for the above applications. One can find in the system a large number of basic and auxiliary tools so that by expanding the existing applications the user can fit them to his own needs, to his existing technologies or business practices or to his earlier computer technology tools.

Those users who undertake such developments or develop their own applications on the above hardware base—having the required designing experience—can use a broad assortment of developmental tools and basic elements which can be built into their system.

The VT32x computers operate under versions of the DMOS operating system which are compatible with one another so the programs developed can run on any of the machines, with various power, of the CADNET network. The DMOS operating system is compatible with the UNIX operating system, widespread and favored throughout the world. In accordance with this dozens of developmental tools are available for developments in the C, Fortran, Pascal or Cobol languages. And there are efficient local network management tools to access network resources in the interactive or data movement mode.

Other line communication links can be formed on an asynchronous line with the KERMIT program or on the synchronous line with BSC and SDLC protocols. Other basic tools are the standard CGI program interface to handle graphic devices and a graphics editor. The concurrent index sequential file management system and the standard network database management system based on it represent great aid in solving data management tasks.

SCIENCE & TECHNOLOGY POLICY

Hungarian Research Institutes Form Electronics Companies

25020242 Budapest NEPSZABADSAG in Hungarian 25 Mar 89 p 5

[Article by Katalin Magos: "The Research Institutes Are Hoping for Good Business"]

[Text] There is a proliferation of economic associations in which Academy research institutes become the brides of banks. The fact that monetary and intellectual capital are finding one another probably derives from two realizations—already recognized and proven west of here. It is becoming increasingly obvious that science is one of the most favorable areas for investment.

Academician T. Ivan Berend, president of the MTA [Hungarian Academy of Sciences], put this in figures thus at the last general meeting of the scientific society: Every forint invested in science creates seven forints new value per year by even the most modest calculation.

And the Academy research institutes no longer consider it beneath them to link up with capital aiding a swifter utilization of the intellectual valuables they create. Fortunately the new association law supplements the two recognitions cited above; it substantially simplifies the former method for forming associations.

Under the patronage of the MTA Nuclear Research Institute in Debrecen a Technical Park was formed in 1987 with the participation of five local enterprises, the county and city councils, the Budapest Industrial Development Bank and the Lajos Kossuth Science University; it has already successfully brought together the capacity of the region and the local needs and national central programs. Last year the economic association had 13 million forints in contracts and this year there are expected to be three times as many. On the basis of experience thus far the directing council recently decided that in the future the park will be operated as a legal firm. According to the plans it will include a limited liability company, an association and even a joint stock company.

The formation in 1984 of a subsidiary enterprise of the MTA Isotope Institute to deal with isotope trade counted as a sensation at the time. Thanks to its effectiveness its authorization, earlier limited to import and domestic supply, was expanded as of 1 January this year to include export activity.

They are also among the first to make use of the possibilities given by the new association law. They are preparing to form a limited liability company specializing in pharmaceutical, primarily kidney diagnostic, research, in cooperation with a Hungarian bank, a bank in the United States and an English research institute.

The MTA Computer Technology and Automation Research Institute (SZTAKI), on the other hand, has had bad experiences with its subsidiary enterprise formed a few years ago to manufacture and sell computers. The swift changes which took place on the domestic computer technology market prompted it to begin to deal with many other things. But the Academy institute was not happy to give its name to the majority of these, nor could it influence its activities. So it has been decided at SZTAKI to transform the subsidiary into a limited liability company within a short time, and to clean up its profile. In recent years SZTAKI was also involved in formation of the Flexis joint stock company, with a mixed capitalist interest, to deal with manufacturing automation themes, and the ITEX limited liability company, to develop printing systems and laser technologies. They also selected the limited liability company form for an association, now being formed, to guide the services of a national research and development information network and Unisoft, being formed with Austrian participation and now awaiting authorization.

The MTA Natural Sciences Research Laboratories also moved to meet up with the association law; a year ago, in association with two banks, it established the General Industrial Development joint stock company with the goal of managing the innovation chain in all its complexity, so that it would not have to stop after research and development. During its brief operation it has established mixed enterprises in several West European countries—England, the FRG and Holland. And these prove that a number of results achieved in our university and Academy research sites can bring economic profit in developed industrial countries. In the future they plan to set up several independent enterprises or limited liability companies; a mixed enterprise with a number of foreign interests is in preparation, among other things for environmental protection and waste utilization themes, to develop agricultural technologies to reduce production costs and to develop new types of instruments.

The ICON limited liability company, operating in the duty-free zone, was founded by the MTA Central Physics Research Institute (KFKI) in conjunction with a Swiss firm. Hungarian science is being tested in this undertaking, established to develop computer technology systems and operating as a foreign exchange alien—it can sign contracts only in foreign exchange. It has been in operation for 6 months, cooperating with the firms of developed Western countries and sometimes selling in competition with them.

The AVIATRONIC Flight Technology Development Deposit Association, registered at the end of last year with the participation of the KFKI and a bank, was established to develop on-board and land-based systems to increase the safety and economicalness of flying and to develop systems aiding the solution of on-board computer technology and scientific tasks in space craft.

This overview, far from complete, shows that the enterprising spirit of our Academy institutes and the investment spirit of domestic and foreign capital owners are increasing. It may be too early to speak of results; capital invested in science never paid off in the short run.

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